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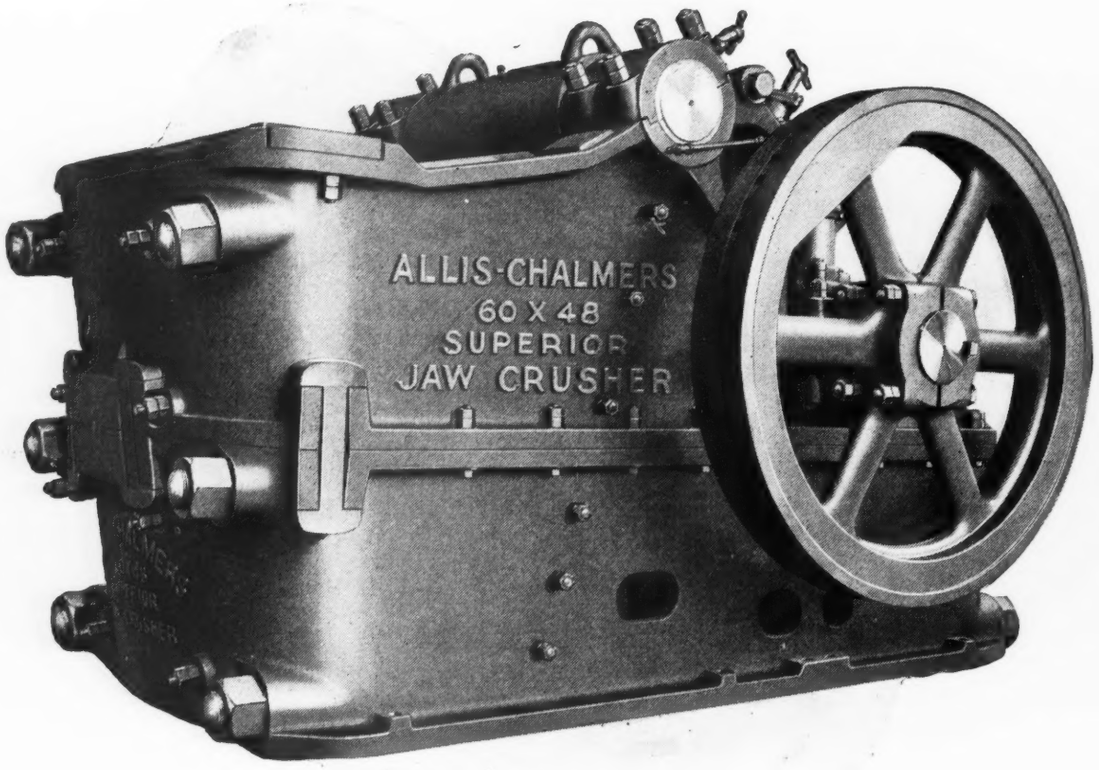

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JAMES H. MCGRAW, *President*

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The Fiction of Unassayable Colloidal Gold

HEADLINES in an evening paper, published in Toronto, announce yet another remarkable discovery—a process for the extraction of colloidal gold! The object of the process, according to the statement, is to extract this gold from all deposits. The metal is said to be in a form "neither amorphous nor crystalline." It consists, we read, of gold in the minutest particles, and "some claim that these particles cannot be found even by the best assaying. . . . That some kind of additional gold exists other than in forms already known is admitted by almost all mine managers," one is told. "Their reason for the belief is that even existing mills using both amalgamation and cyanide quite regularly get a higher extraction from ore than assays of the same ore show to exist. This recovery ratio increases with fine grinding." It is said, according to the report, that "the new process being worked out . . indicates that there is at least $3 a ton of this 'colloidal gold' in almost all gold-bearing ores." Follow optimistic statements of what this amazing discovery will mean to the gold-mining industry.

The recovery of more gold from an ore than the Almighty put in it reminds one of an incident that occurred in Mexico several years ago. An incoming metallurgist greatly improved technical results, only to be chided for a *decrease* in extraction. Inquiry showed that the directors of the enterprise had always been accustomed to reports from the mine that indicated extractions of from 105 to 110 per cent! The technical reorganization had included a necessary modification in sampling practice in the mill, whereby a correct estimate of the grade of incoming material was possible. The improvement in yield was more than counterbalanced by the decrease in apparent recovery. Hence the misapprehension. Those interested in recovering unassayable gold and in manufacturing gold from mercury would do well to make sure how much gold was actually present in the first instance.

The new propaganda in Canada calls to mind similar efforts in the United States a few years ago, to take advantage of an alleged fact that some gold and other precious metals in ores could not be detected by ordinary methods and by experienced assayers. When this scheme—to separate the credulous from their cash—failed to recoup the sponsors, attention was directed to the treatment of oil shale, a bulletin of an enterprising combination announcing that "at first we found no metallic values, except iron, but by using the —— method, his last and sixth test gave $10.80 in gold, $1.68 in silver, and $5.60 in platinum per ton of shale." It was inferred that "laboratories that cannot recover these values simply acknowledge their inefficiency." In commenting on this editorially, *Chemical and Metallurgical Engineering* showed that the sponsor of this scheme had been associated with unscientific, half-baked, and unsuccessful methods of ore treatment; also with methods of assaying that have yielded results unobtainable by reputable analysts.

The claim that precious metals undetectable by an assayer exist in ore is very old. It is extremely unlikely, however, that the gold in any ore exists in the colloidal form; and, if it did, the ordinary fire assay would indicate its presence. Moreover, the encasing of a particle of gold by a siliceous covering does not prevent the estimation of such gold by ordinary methods, contrary to the propaganda of the sponsors of the new process. *Engineering and Mining Journal* is frankly skeptical as to its value, and believes that interested parties would do well to withhold financial support until the subject has been given greater publicity and the alleged phenomenon explained in technical and scientific language.

The Relation of Preventable Hazards to Ultimate Profit

EQUIPMENT that is worn out, damaged or obsolete may be replaced; men may be hired to do the work formerly allotted to those who may have died, to those who leave, or are "let go"; but time lost as a result of the suspension of operating routine is gone forever, and the losses entailed are permanent and usually costly. If this loss of time be chargeable to preventable hazards, the suspicion of poor management is justified. Mention of the avoidance of industrial hazards suggests to many executives only additional capital outlay. So-called industrial hazards comprise—to all and general—unsafe working conditions, unprotected machinery, lack of safety devices, defective equipment, poor judgment, and, especially around mines, inadequate lighting and bad air.

Consideration of a few fundamentals discloses a positive connection between hazards and profits; and a study of ways and means by which delays may be obviated suggests, usually, how such avoidance may become a constantly productive asset of monetary value. The first result of such research should be the perhaps belated discovery of the obvious fact that a manual operation replaced by a mechanical device affords assurance that no workman will be injured in performing the operation. The reduction in hazard in the functioning of the mechanical device is a sequel to more scientific control. A higher type of worker is usually employed.

Not hazards themselves, but their consequences and results, require the study of executives. When a workman is injured, many sequential "griefs" must be faced. Though the actual physical injury—perhaps slight—may affect only one man, others become interested, and their labor temporarily ceases. Sometimes three or four men

are compelled to leave their work to assist the injured man; someone must notify the shift boss or the "super." Others are helping as best they may—often merely standing about to be of service if needed. This state of affairs may compel the shutting down of one or more machines, the disconnection of power, leaving machines and men idle. A fatal accident may so frighten and distress an entire mine or mill crew that production is radically reduced for hours or even days.

The mine or mill executive should know, at least approximately, the total operating costs per hour. If not, he should remain in ignorance no longer than circumstance compels. If accurate computation be made and a test applied, responsible officials will usually discover that, in all operations except those of transitory and primitive type, the high cost of lost time chargeable against preventable interruptions can be more than balanced by the comparatively low cost of safety devices and policies designed to obviate accidents and to prevent hazards.

Putting aside humanitarianism—indispensable and vital though it be in the handling of labor—the reduction of hazards by substituting electricity, compressed air and scientific mechanization for the human hand and mind—making safety automatic, as it were—should be the aim and objective of progressive management in all industrial enterprise.

Analyzing Your Job

AN ENGINEER visiting in New York—one who still is on the youngish side of middle age—is thinking of leaving his present employment unless certain additional attractions develop early in 1928. As jobs go, his would be considered a good one by most technical men of the same age; yet, according to his reasoning, a change is necessary to influence him to stay, and that change is not an increase in salary. His rather ingenious method of analyzing the situation is interesting. He names three major factors or requirements for a satisfactory position: it must afford interest, prestige, and money. To amplify a little:

Under the first head comes the opportunity to travel, to meet new and engaging people, to do original work in technical or economic research; or otherwise to do that which removes the task from the category of the humdrum. To meet the second requirement the employment must be of such a character as to give experience that will enhance his value to present or future employers; or it must give him wider recognition and greater reputation as a professional man. The third requirement explains itself: in these days of complicated civilized existence, financial reward is a matter that cannot be ignored by the average individual.

To these requirements one is inclined to add another, more intangible perhaps but no less important. It is contentment. The others may be present in adequate degree, but unless living conditions—geographic, climatic, social—are reasonably satisfactory the job may be anything but desirable.

Our friend argues that if his analysis shows that any one of the factors he mentions is exceptionally high it will tend to offset delinquencies in the others. A large income, for example, will compensate for many disadvantages. Or an important and responsible position, in which success may bring wide and favorable professional recognition, might offer attractions, even at a comparatively small salary. On the other hand, if one of the factors were close to zero, the place might be undesirable even though all the others rated high. In the ideal situation, all the factors would be about equally high and all would be well above the average—with neither peaks nor pits. Perfect jobs, however, are few and far between, and the best most of us can do is to find one that approaches the ideal within speaking distance. Thoughtful analysis of one's work on some such basis as has been described should prove interesting, if nothing more.

The Function of Metals in Biological Metabolism

THE essentialness of certain elements and compounds in assuring healthy animal growth and reproduction is a feature of the new knowledge acquired by investigators in recent years. Science is on the brink of discovery that will indicate the chemical composition, and perhaps point a way to achieve the industrial synthesis, of those all-important compounds, the vitamins. Now comes organized research in an effort to determine the needs of plants along parallel lines. For instance, does manganese benefit plant life merely by increasing the oxidation powers of the soil, or is its chief value that of a promoter of enzyme activity within the cells? The question is asked by Mr. Forman T. McLean, in a monograph issued recently by the Rhode Island Agricultural Experiment Station. Accepting as a fact the need for manganese in the treatment of neutralized soils, Mr. McLean has carried out a program of research involving the injection of a manganese solution into the tissues of a growing plant. The results indicate an average increase in growth amounting to 30 per cent; they prove that what is known as "lime-induced chlorosis" may be cured by the action of manganese within the body of the plant. The corrective was equally efficacious whether applied thus or to the soil.

Other researches, by Mr. A. L. Sommer, of the University of Minnesota, discussed in a recent issue of *Science,* indicate that copper and zinc have an important influence on plant life. Zinc was proved to be an essential element in the growth of barley, wheat, and bean plants on which the tests were made. Without zinc, some of the plants died in early life; the beans, however, appeared to grow well until the flowering stage was reached; then a rapid decline set in. No seed was produced by any of the plants not supplied with zinc. The delicacy of the work is indicated by the fact that, if an ordinary glass jar be used for the test, it furnishes all the zinc needed by the plant. In fact, the plant's requirement in this respect was not discovered until experimental jars of pyrex glass were used. Research then showed that copper is probably also an essential element to healthy plant growth and reproduction.

These indications may be of no immediate significance to the producers of manganese, copper, and zinc, but they provide food for interesting conjecture. A little learning may be a dangerous thing, but Pope was undoubtedly discouraging superficiality in education when he coined the aphorism. The knowledge that is power includes comprehension of the insignificant and the apparently unimportant.

Receiver Is Named for Idaho Copper Company

SEVERAL weeks ago the Idaho Copper Company suspended operations at its mining properties. An Associated Press dispatch from Weiser, Idaho, dated Nov. 26, gives this further information:

"A receiver was named today for the Idaho Copper Company, controlling the Red Lodge and South Peacock mines, in this state, and the Iron Dyke mine, in Oregon. . . . The receivership was granted on petition of the Boise Association of Credit Men, who sought collection of $40,000."

The Idaho Copper Company is a merger of interests controlled by Mr. Cooley Butler—a brother of Justice Pierce Butler of the United States Supreme Court—and several presumably reputable associates, with the Idaho Copper Corporation, a company owning no mining property of proved value and dominated at the time of the consolidation by George Graham Rice, notorious vendor of mining stocks. According to advices to the New York *Times*, Mr. Butler and his associates "instigated the receivership for the company's protection in a financial squabble which developed between it and Rice." However that may be, it is clear that the company is in financial straits.

Nine times out of ten, when "respectable" mine owners ally themselves with unscrupulous promoters they attempt to justify their action by explaining that they are unable to raise money to develop their property in any other way. The crooked promoter is prepared to put a little cash in the treasury, and his partners contend that the spending of this money—principally as wages—helps the surrounding country as well as the mining property itself, and warrants them in entering into an alliance of which they are not proud. *Engineering and Mining Journal* always has maintained that this contention is unsound. In this particular instance Rice took options on 1,250,000 shares of Idaho Copper Company stock at prices ranging from 10c. to 30c. per share. The other shares were placed in escrow, so that they could not interfere with Rice's market operations. He, shortly, had the shares listed on the Boston Curb, where, by well-known methods, he boosted the stock to more than $5 per share. The market was brisk, and Rice sold many thousands to the public at prices ranging well above $4. These same shares he bought, as he needed them, at prices ranging from 10c. to 30c. Presumably, the greater part of what Rice paid found its way into the treasury of the company and served to finance operations for a time. However, the amount of money realized in this way was pitifully small compared with the amount that Rice put into his own capacious pocket. Out of $100 so obtained, the promoter in a shady financial operation like this usually gets about $95.

Rice featured the names and reputations of his partners freely in the publicity he used in rigging the market. They suffer, merely by having their names associated with his. But aside from all this is the fact that Rice personally reaps the big profit and leaves only the crumbs for the "development of the mine," the really worthy project for which the decent element contends that it has been striving.

It is probable that by this time Mr. Butler and his friends and business associates wish heartily that they had never succumbed to the blandishments of George Graham Rice.

Publicity for Quality Products

ALTHOUGH producers of ores, concentrates, or crude or refined metal can employ few of the customary methods for increasing the demand for their products, as was pointed out in these columns recently, it is interesting to observe that publicity for the non-ferrous metals is by no means being neglected. In a recent issue of *Saturday Evening Post*, for example, appeared advertisements for copper, brass, and bronze products put out by Anaconda; a page was devoted to the advantages of a zinc paint as developed by the New Jersey Zinc Company; one on aluminum paint was sponsored by the Aluminum company; and the second in a series of advertisements in which the Chase Brass & Copper Company says a few words for brass pipe in general, and for its Alpha brand in particular. The Chase advertisement has an element of novelty, with its Gluyas Williams cartoon and its entertaining anecdote; the series of advertisements of which it is one should be widely read. The more Saturday night baths that are taken in clean water from brass piping, as suggested, the more copper, zinc, and lead will be used. After all, however, the layman—the ultimate consumer of a finished manufactured product—is not a particularly important factor in influencing the consumption of a metallic product. It is chiefly the manufacturer who must be persuaded that copper, zinc, lead, aluminum, nickel, or other metal is superior for his purposes to the material that he has heretofore used.

The Scope for Industrial Investigative Work

A WAITING LIST is usually an excellent indication that an institution is fulfilling its functions and performing useful service. It is not generally known that the Mellon Institute of Industrial Research of the University of Pittsburgh has been self-supporting since 1920 and that the demand by industrial firms to be allowed to establish fellowships there is in excess of immediate facilities. Those planning a systematic program of research should bear in mind a growing recognition of the value of such industrial investigative work under well-organized and adequately equipped conditions.

Another indication of appreciation is seen in the fact that some of the permanent research workers of the Institute are receiving incomes, from industrial firms that have benefited, in amount in excess of what is being paid them by the Institute for their services. It is fair that such rewards should be made, especially in view of the fact that patents relating to discoveries made at the Institute are the property of the firms financing the work.

American industry owes much to the Secretary of the Treasury, Mr. Andrew W. Mellon, and to his brother, Mr. Richard B. Mellon, for their foresight and generosity in endowing the Mellon Institute. The inception of the project was due to Dr. Robert K. Duncan, who combined Francis Bacon's idea of a palace of invention and a temple of science, outlined in allegory in "The New Atlantis" in the seventeenth century, with modern opportunities in industrial investigative work. The results have been gratifying to all concerned. No greater service to industry and humanity can be performed than by the encouragement of such research as is being done at the Mellon Institute.

Mining Men of Note

J. CARSON ADKERSON

President, American Manganese Producers' Association

IN EPITOMIZING the career of J. Carson Adkerson, president of the American Manganese Producers' Association, stress should be put upon his courage in fighting for things in which he believes, his broad and intimate knowledge of the manganese industry, and his perseverance in overcoming obstacles. Beneath a pleasing personality he possesses a determination to succeed which has won for him the confidence of his associates and has given him an outstanding position in his chosen field. Mr. Adkerson was born in Lynchburg, Va., in 1892, a son of Alonza Thomas Adkerson and Elizabeth Carson Adkerson, and his charm of manner bespeaks the Cavaliers from whom he has descended. Among his forebears are Col. William Callaway, a soldier in the Continental Army; and Col. Jeremiah Early, who served under Washington and who was the great grandfather of General Jubal A. Early, of the Confederate Army. Gabriel Penn, a kinsman, was a signer of the Declaration of Independence and a near relative of William Penn, founder of Philadelphia. Mr. Adkerson's mother is a blood relative of the scout and frontier hero, Kit Carson. It was as mining engineer with the Piedmont Manganese Corporation, of Lynchburg, that Mr. Adkerson began his career in manganese, in 1912. The fascination of studying this comparatively little known mineral prompted his specializing in this field, and since then he has been identified with manganese production and research, in every phase of the industry.

J. CARSON ADKERSON

While at the Piedmont mines Mr. Adkerson was engineer on construction and operation of the company's concentrator, in addition to the development of the mines. Subsequently he was with the Oxford Mining & Manganese Corporation. He was one of the first mining engineers to pass the Virginia State Board and to receive a license as such. In 1914 he was engaged in examining manganese properties throughout the United States and in sections of Canada, and in 1915 he became manager of the Powell's Fort Manganese Mines, near Woodstock, Va. Under his direction this property became the largest producer of high-grade chemical manganese ore in the United States. From 1916 to 1919 he was engineer and manager in charge of manganese-mining operations of the National Carbon Company, of Cleveland, largest consumers of battery-grade ore. Since 1919 he has been consulting engineer to various manganese interests. He is engineer and manager of the Hy-Grade Manganese Company, of Woodstock, Va., where with his associates, he is developing one of the richest and most extensive manganese deposits in the South. For eight years he has succeeded in keeping the company's Mineral Ridge mine on a pay-as-you-go basis from ores taken from development work, and this without concentration or other treatment until recently. The mine has one of the largest blocked-out bodies of domestic high-grade ore.

Mr. Adkerson made a strong defense of the domestic manganese industry at the meeting of the A.I.M.E. in Cleveland last April. Following that meeting he was instrumental in forming the committee which paved the way for the organization of the American Manganese Producers' Association in Washington on Aug. 2. Owing largely to his initiative, producers were informed of the situation and convinced of the need for co-operative measures. Because of his experience and familiarity with the entire situation he was chosen as president of the association.

Electrolytic Zinc Plant Practice: A Review

By ARTHUR A. ZENTNER
Research and Metallurgical Engineer, San Francisco

THE SOLUTION and electrolytic precipitation of the zinc in high-grade selective flotation concentrates, and the subsequent recovery of the accompanying metals, are graduating from the pilot plant to the commercial stage, so comment on past and present practice, and indicated developments in the future, should be of interest. A complex ore will be considered in this article to be one containing copper, lead, zinc, silver, and gold. Flotation will be considered only as it affects practice in electrolytic zinc plants; and dissolving of the zinc with sulphuric acid and subsequent electrolysis of the sulphate solution only are given attention. Solution contents are expressed in percentages because the meaning of these is easier to comprehend than grams per liter.

FOR the first electrolytic zinc plants built subsequent to 1914, the feed was concentrate obtained by collective flotation—that is, all the sulphides in the ores were concentrated into one product. An acid circuit was used in the flotation plants. It is evident that the more iron, copper, and lead an ore carried, the lower would be the grade of the resulting concentrate in zinc. A product of 33 per cent zinc, or 50 per cent zinc sulphide, was considered good. Iron, copper, and lead sulphides and gangue matter accounted for most of the remaining 50 per cent.

The last few years have seen remarkable progress in the selective flotation of sulphide ores in an alkaline circuit. Flotation of oxide ores remains more difficult. Most of the iron is either sent into the tailing, or taken out as a separate product which may be used as a smelting flux, for sulphuric acid manufacture, and in other ways. The copper, lead, and zinc are being concentrated into three separate products to an increasing extent, these going to copper, lead, and zinc plants for their respective treatment. Silver and gold follow the base metals in varying proportions and are recovered in subsequent operations. The separate concentrates are floated from the gradually impoverished ore pulp in successive stages, or floated from a bulk concentrate produced initially. If either the copper or lead content of the ore is too small, a separate product is not made, the procedure being determined by the method which gives the best economic results. The practice now is to keep the zinc plant concentrate up to 50 per cent zinc if possible. This means 75 per cent zinc sulphide, leaving only 25 per cent of iron, copper, and lead sulphides and gangue matter.

TO assure convenience, the present type of electrolytic zinc plant as exemplified by those of the Anaconda Copper Mining Company at Great Falls, Mont.; of the Consolidated Mining & Smelting Company of Canada, Ltd., at Trail, B. C., and of the Electrolytic Zinc Company of Australasia, Ltd., at Hobart, Tasmania, will be designed as "standard." The last-mentioned plant differs in several ways from the first two, but operates along the same general lines. Anaconda's new plant, now being built at Anaconda, Mont., is similar to that at Great Falls. The one now being built by the Bunker Hill & Sullivan Mining & Concentrating Company in conjunction with the Hecla Mining Company at Kellogg, Idaho, will be designated as the Kellogg plant. The process used at the last-named plant has gone through laboratory and pilot-plant stages and will soon receive its initial tryout on a commercial scale. I have endeavored to maintain an unbiased attitude with regard to the various plants and processes, in accord with the expressed purpose of this article, and costs are not dealt with, as no statement fair to all concerned can be made at this time.

The statements made above on flotation are in connection with the standard type of plant. The Kellogg plant, treating a lower-grade concentrate, is expected by its sponsors to equal the work of the standard plants with their high-grade zinc concentrates, and to do better work on oxidized zinc ores.

WHEN the process of making electrolytic zinc was being developed it was expected that the roasting operation would not be troublesome. The several companies had roasting plants (McDougall furnaces or modifications thereof) that stood up well mechanically and were operated by practical roaster men with years of experience. Experience in the retort roasting of zinc could also be drawn on. However, it was soon found that previous work had little application in getting maximum tonnage and solubility on a material screening 90 per cent through 60 mesh and carrying 25 to 35 per cent zinc, 10 to 20 per cent each of iron and lead, and 35 per cent of sulphur. Air had to be admitted to the upper hearths to prevent the excessive formation of ferrates and also to prevent the charge from piling up in front of the rakes like wet snow. Sufficient draft was necessary to permit the addition of this cooling air and also sufficient external heat was necessary at the bottom of the furnace to practically eliminate sulphide sulphur. For the so-called oxide roast in the early days, the temperature was held around 550 deg. C. near the top of the furnace and was raised to 650 deg. C. at the bottom. A 25-ft. diameter Wedge furnace roasted 40 to 45 tons of concentrate. Coal, in amount equal to 10 to 15 per cent of the weight of the ore, was burned, depending on chemical and screen analyses and the physical composition of the feed. Large amounts of sulphuric acid had to be added in the treatment plant to replace the losses of single-stage agitation and solution and the comparatively imperfect practice of that time. Acid was then three times its present price, so the zinc sulphate roast

(not the Coolbaugh roast) was worked out at the Great Falls plant. It may be noted here that the application of coal-dust firing to multiple-hearth roasters was also worked out at this plant. Furnace speed and temperatures were reduced, but the coal consumption and flue-dust production were raised somewhat by the increased use of air. Furnace capacity was reduced very little and operating ratios were greatly improved by its use at that time. When the double agitation was developed and other plant losses were lessened the problem changed from shortage to excess of acid, and roaster practice was changed accordingly.

The present high-grade zinc concentrate requires a higher temperature to roast off its sulphur—around 750 deg. C. Trail, with its high zinc, 50 per cent, but also high iron, uses a lower temperature and floats the residue from the agitation tanks to recover unroasted zinc sulphide, which is returned to the roasters. The Hobart plant roasts in two stages—the first to produce sulphuric acid for phosphate manufacture, the second to finish the roast for agitation and solution.

EXTERNAL heat has been applied by grate, coal dust, and oil firing. Using oil, the flame can be introduced directly into the furnace, thereby saving heat losses from fireboxes. The calcine is passed through coolers and screened, the oversize being ground. At Trail, the calcine cools during transmission to the agitation tanks, which is done in a cast-iron pipe conveyor with an internal flight, the conveyor revolving on rollers.

At the Kellogg plant the normally insoluble ferrates are expected to be dissolved, so that the roasters can be crowded to greater capacity without regard for ferrate formation. Equipment of the same type as that used in the standard will be used.

To state past practice briefly, single-stage batch agitation in pachucas was the plan generally followed during the first few years. To the acid solution, 6 to 8 per cent, returned from the cell room, calcine was added until the acid content was down to 0.5 per cent. Manganese dioxide was the usual agent employed to oxidize the ferrous iron in solution. Limerock was added to neutralize residual acidity, precipitate the dissolved silica, iron, arsenic, and antimony, and to coagulate the solids for efficient settling. The amount of residue from low-grade material was large, about two-thirds of the weight of the calcine. The moisture in the residue was high, rather over than under 40 per cent, and losses of undissolved zinc oxide and entrained zinc sulphate were large. Plant recoveries therefore were poor, but maximum production of the high-priced zinc was the prime factor. After mechanical and operating difficulties were worked out to secure fairly continuous operation, attention was turned to increasing the recovery.

BECAUSE of the necessity of obtaining a neutral solution for purification purposes, the two-stage or double-agitation plan was developed. The first stage, or neutral agitation, produces the neutral solution required; the second stage, or acid agitation, treats the solids from the first. This plan permits neutralizing and coagulating the first solution with excess calcine, eliminating barren limerock and the resultant bulky calcium sulphate precipitate from the residue. It also permits discharging from the plant the less bulky, more easily washed, higher-grade acid residue. Selective flotation has further reduced the amount of residue formed, and it is now only one-half that formerly handled. No part of the acid or second stage of the work is permitted to become neutral. This insures against the precipitation of any basic sulphates and loss of undissolved zinc oxide. Pachuca agitation on both neutral and acid sides was changed from the batch to the continuous system.

AS MECHANICAL equipment was improved and purity of cell solution maintained at a higher level, the acid content of the cell acid was raised to lessen the amount of solution circulating through the agitation tanks and electrolytic departments. At present, acid content is kept over 10 per cent and the zinc content of the purified solution has raised proportionately. Formerly the acid content was as low as 6 per cent, one reason being the effort to keep down the loss of zinc sulphate in the filter cake. Treatment of the purification residue was also undertaken to increase the recovery of zinc, and is discussed under purification. Extraction of zinc now reaches and exceeds 90 per cent.

Plant equipment has been borrowed largely from cyanide practice, modified where necessary. Agitation has been done in pachucas. As has been stated, it was formerly done in batches, but it is now a continuous operation through a series of from three to six tanks. For settling, Dorr thickeners have been used since the beginning, with Genter vacuum tubes used in the thickeners at Trail. Counter-current decantation was once practiced there, but has been abandoned. Oliver, American, and Moore filters are used for filtering residues at the different plants.

THE extraction process at Kellogg will differ from that of the standard plants in several ways. Strong acid is stated to be the cardinal point of this process, the other departures from standard being largely the result of adjusting these operations to make the most feasible use of the high acid strength. The cell acid returned for dissolving the zinc will contain about 28 per cent acid and will be heated to 60 deg. C. before calcine is added. Heat generated by chemical reaction will bring the contents of the tank up to the boiling point. The calcine will be passed over magnetic separators to form high- and low-iron products, the high-iron product containing nearly all the relatively insoluble ferrates, whereas the low-iron product should be a high-zinc material with little insoluble zinc. Single-stage batch treatment will be practiced.

The high-iron calcine, in the proportion made, will be fed into the acid first and agitation completed with low-iron calcine. Details of how neutralization and coagulation are accomplished have not been given out. Solution of practically all the copper in the calcine is also claimed as an advantage. When the iron-zinc oxides are attacked by acid, iron as well as zinc goes into solution. It is expected that the amount of iron hydroxide precipitated will be more than enough to carry down all dissolved arsenic and antimony, but that an excess of iron will not prove a hindrance under the conditions of the process. (The standard plant solution has tended toward deficiency rather than excess of iron, so iron has been added when needed.) With the mass at boiling point and with the zinc content high—over 20 per cent—the precipitated silica is more granular than usual, and is supposed to make the iron hydroxide more easily filtered.

ZINC extraction will be done in mechanically agitated tanks because of the high pulp density and also to conserve heat. It is expected that thickeners will not be

needed, except for high-grade calcine. In other words, the pulp residue will go directly to the filters, the Burt revolving pressure filter being used for this operation.

Purification of the zinc solution from arsenic and antimony has already been mentioned. The harmful elements remaining are principally copper, cadmium, and cobalt, which are precipitated by metallic zinc. Copper requires little excess of zinc, but cadmium requires a considerable amount to precipitate it down to the operating limit. Cobalt, when present, has been even more difficult and costly to precipitate. The Australian operators have had, and the Kellogg plant will have, more cobalt to contend with than the others. It has been removed by adding dissolved copper and arsenic to the heated solution and then precipitating all three with zinc dust; also by the addition of nitroso-beta-naphthol.

Pachucas were used for some time as purification equipment, but it was found that air tended to cause re-solution of the cadmium. Mechanically agitated tanks therefore proved better for this purpose. The tanks are operated singly and not with a continuous flow. Zinc dust is made by atomizing molten zinc with an air jet.

Thorough elimination of the cadmium requires quite an excess of zinc dust. Purification residue is therefore treated with cell acid, which dissolves the excess zinc and the cadmium, leaving a higher-grade copper product for the copper smelter. The bulk of the cadmium is reprecipitated and the resulting solution sent back to the zinc circuit. The cadmium sponge is redissolved and obtained as metal by electrolysis.

IN the Kellogg plant the temperature of the zinc solution will be kept as near boiling as possible. It should also be remembered that nearly all the copper in the calcine will be in solution. Under these conditions it is expected that cobalt will give no trouble in the precipitation by fine zinc. Mechanically agitated tanks will be used as in the standard process, but the fine zinc will be made by grinding cathodes in a ball mill. The excess zinc is to be dissolved by the hot, strong zinc sulphate solution sufficiently so that it will not be necessary to treat the purification residue for its recovery. Filtration of solution before flowing to the electrolytic department will be done by pressure plate presses, as in the standard plant. It is also stated that, because of the higher zinc content of the solution, the cadmium content need not be reduced to so low a figure as in the standard plant, and that the higher current density used in electrolysis permits larger amounts of impurities to be present.

The purified solution at one time contained as low as 6 per cent zinc. This solution made one passage through the cells, during which the acid built up to 6 per cent and the zinc dropped to 2 per cent. A current density of 20 amp. per square foot of cathode surface was employed and the voltage drop per cell was nearer 4 volts than 3.5. A cooling coil was placed in nearly all cells and the temperature kept as low as possible. Consistently good purification, prevention of fouling in the cells, and short-circuiting had not been attained. Low acid and temperature were necessary to keep down re-solution. High voltage was caused in part by poor contacts. Cathode zinc was stripped every two days, but the ampere efficiency was 10 per cent lower during the second day than during the first; to obtain an average ampere efficiency of over 70 per cent and an energy efficiency of over 40 per cent was considered good work. The cell acid was gradually raised to over 10 per cent acid and 3.5 per cent zinc, the current density to 30 amp. and the purified solution to better than 10 per cent zinc, though recently the tendency has been toward still higher acid and zinc contents. Coincidentally, as practice has improved, the voltage has been lowered to nearly 3.5. There has also been a tendency to let the cell temperatures rise and to shorten the period of deposition to one day. Good practice now requires 90 per cent ampere efficiency and 60 per cent energy efficiency.

LEAD anodes and aluminum cathodes have been used from the beginning, being suspended 2 in. apart, center to center, in either lead-lined or sulphur-sand lined concrete cells. The electrodes are about 2x3 ft. immersed area. A cell contains from 16 to 27 cathodes and one additional anode, and there are no spacing racks within the cells. About six cells are set in cascade formation, with purified solution fed to all but the lowest. Chain blocks and lifting racks are used to remove eight or nine cathodes at a time for stripping. Both rotary converters and motor generators supply direct current, the number of cells varying from 36 to 144 per unit of current supply.

The purified solution to be sent to the Kellogg plant cell room will contain over 20 per cent zinc, and the liquor returned to the agitating tanks will be 28 per cent acid. A current density of 100 to 120 amp. per square foot of cathode area will be used. The voltage drop per cell is expected to be the same as in a standard plant, the higher acid and closer spacing of electrodes, one-half inch less, having a beneficial effect in this regard. Cell temperatures will be no higher than in the standard plant, and the cells are not to be placed in cascades. The overflow of each will go to a common sump, from which a portion of the acid will be sent to the agitation tanks and an equal amount of purified solution mixed with the remainder for return to the cells. Apparently, cell solution will be circulated about a half dozen times before it returns to the agitation tanks. The zinc and acid contents will be raised somewhat by evaporation—that is, they will be higher than would be produced by electrolysis alone. In the standard plant evaporation is a more negligible factor.

WOODEN cells lined with lead will be used, placing two lead anodes for each aluminum cathode. Electrodes will be about two-thirds of the size of those in the standard plant, and anodes will be perforated below solution level. Instead of cooling by coils immersed in the solution, the circulating acid is run over wide, shallow launders containing cooling pipe, so that advantage is taken of the cooling effect of evaporation. This evaporation will also permit a greater amount of wash water to be used in the Burt filters, and other reasons as well influence the selection of this method of cooling. It is expected to operate upon the basis of a 24-hour stripping period, with ampere and energy efficiencies equal to those of the standard plant. Motor-generators will be used to supply the direct current.

Reverberatory furnaces have been and are being used to melt the cathode zinc into commercial slabs, with coal, oil, and electricity as a heat source. Electric heating by a resistor trough did not prove superior at Great Falls and was abandoned. Charging through side doors was formerly practiced, but has been replaced by top charging. Zinc melts at the low temperature of 420 deg. C. but the blanket of dross formed acts as a heat insulator, so that a temperature considerably above melting is required to get good capacity out of a furnace; this, with

the tendency of zinc to volatilize when a furnace is forced, makes a simple problem more difficult. After a day's production has been melted down the dross is rabbled with a small quantity of sal ammoniac to remove as much zinc as possible, after which it is rabbled out of the furnace and given another sal ammoniac treatment in a revolving drum. The final dross is sold as such or returned to the plant. Good practice now requires dross production to be kept under 4 per cent, though formerly it was 6 per cent. Casting is done by hand or mechanically; the former produces a more attractive, smooth slab that is difficult to attain by the latter method.

IN the Kellogg plant a revolving electric furnace will be used for melting cathodes and it is expected that this method will not require a sal ammoniac treatment of the dross. The furnace is expected to yield less dross, the amount being reduced further by the production of thicker cathodes.

Aside from the cadmium, copper, and silver recovered from the purification residue, the residue from the solution tanks contains copper, lead, silver, and gold where these metals are present in the concentrate treated. There is also the unrecovered zinc, as well as the iron, gangue matter, and other constituents. Reverberatory smelting, forming a high-silica slag to fume off the zinc and lead, was tried, but this was not found feasible, either from a smelting standpoint or zinc plant treatment of the fume. A slag higher in zinc and less siliceous, more economical from the smelting standpoint, was then made. The copper, silver, gold, and some of the lead went into matte, the remainder of the lead and some of the zinc forming a fume. The rest of the zinc went into the slag. Matte was converted to form a blister copper, carrying the silver and gold, the lead in the matte joining the furnace fume, both being handled as a lead product.

Brine leaching was also tried with fair success. It is expected that a modified brine-leaching process, giving promising results on lead concentrator tailings, will be used to treat the residue from the Kellogg zinc plant. The residue at all standard plants is at present sent to a lead smelter, the metal content being recovered by the usual methods of lead smelting. Zinc in the residue therefore goes into the lead slags.

EFFORTS to recover the zinc in the zinc plant residue have not lagged, and two important developments are taking place. At the Trail plant, smelting in an electric furnace is being done on a semi-commercial scale, and it is hoped to develop an economical method of recovering the zinc from the lead-zinc fume. In addition to recovering other metals, there is the possibility of producing iron where freight costs are high. The other development is that of the Anaconda company at the East Helena smelter of the American Smelting & Refining Company. This lead smelter has been taking the zinc residue of the Great Falls plant for several years, during which experiments were made by the Anaconda company. The first unit of a slag-treating plant should now be about ready to operate. A description and results will no doubt be published at the proper time, in keeping with the past liberal policy of this company. However, it is commonly known that the zinc in the slag will be driven off as a fume by means of a coal-dust blast. The zinc fume precipitate will be shipped to the zinc plant.

What will be the trend of future developments? What will the plant and practice of the future be like? A statement upon this subject will be necessarily open to criticism from many angles, with ensuing endless discussion. Nevertheless, they are the spice of an article of this kind, and a few ideas are offered. I believe that the trend of flotation will continue to be toward very fine grinding and selective flotation, producing as high-grade copper concentrates, lead concentrates, iron concentrates, and zinc concentrates as are possible. In other words, the effort will be to make the material treated in an electrolytic zinc plant as high-grade as can be done. The splendid work upon the Sullivan (Consolidated) ore brings up the question as to how much absolutely unseparable zinc-iron sulphide there is in ores. The Sullivan ore is just about as unpromising as any I have seen. The high-zinc, low-iron concentrates require higher roasting temperatures. Just about all the iron combines to form the zinc-iron oxides in the roasting furnaces now used. Such being the fact, the field is open for other means of driving off the sulphur.

FOR dissolving the zinc the tendency from the beginning has been toward higher acid, higher zinc content, and higher temperatures, but the advance could not go beyond the development of equipment capable of doing what is required and of standing up under the severe conditions imposed. Installation of a Moore filter at the Great Falls plant brings attention to the fact that a thoroughly satisfactory filter for zinc plant residues has not been developed. In the purification step, cadmium, as stated, requires a large excess of fine zinc, all of which has to be produced again as metal in every cycle. Here the field is open for a method which does not require this turnover. While on the subject of cadmium, I wish to call attention to its supposed effect on zinc ampere efficiencies. An impression has gained ground that small amounts of cadmium increase rather than decrease zinc ampere efficiencies. Results would indicate this to be true, but it should be remembered that the ratio of cadmium to zinc deposition is 1.72 to 1, and I am of the opinion that if the amount of cadmium deposited with the zinc is allowed for at the cadmium rate, the results would show that small amounts are not helpful. Increased re-solution of zinc caused by larger amounts of cadmium more than offsets the error of not calculating the cadmium deposited at the cadmium rate.

Attempts to use zinc starting sheets in the cell room, thus eliminating the aluminum cathodes, did not prove feasible. The high price of aluminum sheet and the low price allowed for aluminum scrap, besides other advantages that might be gained by using a substitute, make this subject an inviting field. Melting of zinc cathodes should take place in the absence of air, so some form of electric furnace for this purpose seems a logical development.

I BELIEVE the zinc plant of the future will use as high zinc and acid solutions and temperatures as equipment and operating conditions permit. Temperatures should be as high as may be maintained without excessive external heating. The current density will be as high as the cell room will permit without excessive circulating and recurrent cooling before returning the solution to the agitation tanks. Current density will also be limited by the necessity of keeping down power consumption. In short, zinc-plant practice of the future will more closely approach what has been established as theoretically possible and logical in the laboratory. The trend of residue treatment has been shown by the late developments given before.

An Efficient Kiln for Firing Refractories

KILNS are used for calcining several non-metallic minerals and for firing refractories. The following description of an efficient kiln of the "tunnel" type, abstracted from Bulletin No. 15 of the American Refractories Institute, may suggest applications in the mining industry. The car-tunnel kiln operates on the continuous system in which the fires are stationary and the brick or other material moves past the fires. In these kilns the rate of application of heat is constant, the control is exact

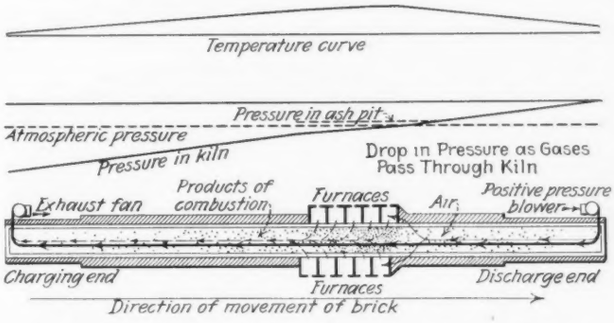

Diagram of tunnel kiln. Heavier shading indicates zones of higher temperature

and flexible, and heat that would otherwise be lost is saved by regeneration. The regenerative principle used is that of counter-current flow of the ware to be fired against the air and products of combustion. Bricks that are to be fired are set on small cars and pushed through a tunnel, generally from 400 to 500 ft. long. The furnaces are placed near the center of the tunnel, usually from two to seven furnaces on each side, and staggered. Brick, in its movement through the tunnel, is first preheated by hot gases that flow in the opposite direction; then it is heated to its finishing temperature and soaked in the firing zone, and finally is cooled in the cooling zone, where it gives up its heat to the counter current of air. The cars have refractory floors, and the metal parts underneath are protected against overheating by sealing and cooling arrangements.

Kilns of the direct-fired type can be built and operated at less expense than those of the muffle type. A number of them are being used to fire refractories. In the direct-fired car-tunnel kiln, the air that is to be preheated is passed through the setting in the cooling zone of the tunnel, and the products of combustion pass from the furnace directly into the tunnel and setting, then out through the setting in the preheating zone. This is illustrated in the accompanying simple diagram. This figure shows the main stream of air flowing through the kiln from the discharge end to the charging end; in flowing through the kiln it is heated by contact with the cooling brick and by mixing with the hot products of combustion in the firing zone and, mixed with the products of combustion, forms a large volume of hot gas to carry heat to the preheating zone. The figure shows a second stream of preheated air taken from the cooling zone of the furnace for combustion. Gases are moved through the tunnel by two main fans—a positive pressure blower at the discharge end of the tunnel and an exhaust fan at the charging end. The actions of these two fans are balanced so as to obtain the desired draft in the tunnel. An auxiliary fan supplies primary air for combustion at the furnaces. The upper curve in the sketch represents the temperature in such a kiln. The rate of heating in the firing zone can be controlled at the furnaces. In the heating zone the rate of heating can be reduced by taking out some of the hot gases at any point, or additional air can be put in. The rate of cooling can be increased or decreased at will by adding more cooling air or taking out some of the cooling air. Usually the cooling can be done fairly rapidly, and the positive-pressure blower is operated to put more air into the cooling zone than is wanted in the firing and heating zones; part of the air is then taken from the tunnel at some point between the discharge end and the firing zone and used in the driers, or for heating the plant. The lower curve represents the drop in pressure as the gases pass through the kiln. Ordinarily, the fans are balanced so as to give atmospheric pressure at the tops of the cars at the point where the gases enter the firing zone; this results in a pressure somewhat lower at the other end of the firing zone. The line marked "pressure in ashpit" represents primary air supplied to the furnaces at a pressure above atmospheric by the auxiliary fan.

These kilns are fired with natural gas, producer gas, oil, coal, or powdered coal. Simple furnaces are used. Car-tunnel kilns have the advantage that the furnaces are operated at a constant rate and can be designed to give the maximum efficiency at that rate. For the tunnel kiln the furnaces should be large enough so that combustion is completed in the furnaces before the gases come in contact with the ware. The fuel is usually burned close to the level of the tops of the car.

Alcohol as a Motor Fuel

EXPERIMENTS now in progress at the Joseph Technical University of Budapest in connection with the use of gasoline and 10 per cent alcohol in a specially constructed motor are mentioned in "Foreign Trade Notes" of the U. S. Department of Commerce. These two fuels must not be mixed beforehand to be used by this so-called "Kund Motor." They are kept in separate tanks and have separate carburetors, meeting only after vaporization. The two carburetors are actuated by a governor, so that they alternately feed the motor according to the varying load.

One of the advantages claimed for this system is that alcohol-gasoline mixtures stand a higher compression than pure gasoline without causing the motor to knock. The Kund system utilizes the calorical value of fuels to a higher degree, which permits a greater motor efficiency with less fuel. One of the possible disadvantages of the Kund motor is its complicated mechanism.

It is stated that laboratory experiments have shown that up to 70 per cent ordinary unrefined alcohol can be used with the Kund motor.

A new fuel recently has appeared in Brazil, said to be made by combining alcohol and ether, both made from sugar cane, with a small admixture of castor oil for lubricating purposes. This fuel differs from local predecessors in the use of ether, former efforts having been directed mostly toward producing higher test alcohols. The government of the State of Pernambuco has taken interest in this new product, which has gained much popular favor under the name of Usga, representing the initials of the name and address of the sugar mill where it was developed.

Swing-Hammer Crushers—

Their Design and Application

PART II

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IF THE ARRANGEMENTS of the internal parts of percussive crushing machines are many and various, the shapes, dimensions, and weights of the hammers present an even greater variety. Fig. 16 illustrates the forged hammer in its simplest form, comprising a short length of rolled bar of rectangular section with a punched or drilled hole and a rounded end. Made of high-carbon or chrome steel, these hammers are usually hardened for about one-third of their length measured from the striking edge. It is desirable that the shank should be left as tough as possible. Occasionally the bar is twisted, as in Fig. 17, to give a broader cutting edge, but these are not common in hard-stone crushers.

Manganese steel, with its great ductility and high resistance to abrasion, has proved exceptionally serviceable for making hammers, and when this material is adopted the hammers are made as castings with the shank lightened, as shown in Fig. 18, to reduce the amount of waste material.

It is natural that the striking edge should quickly become rounded under the continuous abrasion, and where the efficiency of the final reduction process depends on the shearing action it is necessary to restore the shape at frequent intervals. The three simple hammers already described may each be changed round to give two distinct cutting edges, but the Jeffrey reversible hammer, Fig. 19, is designed to give four striking edges and the bar is narrowed in the center to a more economical section.

For certain kinds of work heavy sledges with massive heads, as shown in Fig. 20, are found to be more efficient than a greater number of narrow-faced hammers. They have the advantage that the gaps made by the spacer disks are partly filled by the overhang of the head on either side of the shank, which gives a cleaner sweep. The striking edges are usually square and parallel to the axis of the rotor, conforming also to the internal faces of the screen bars, but in at least one instance the edge is V-shaped to correspond with circumferential grooves in the gratings. The hammers in these machines are illustrated in Fig. 21.

Wear on the hammer rod and in the pin hole through the shank is not often a serious item in comparison to the loss by attrition at the striking end. There are cases, however, where the hammer heads last longer than the pin holes, and bushes are fitted as shown in Fig. 22 to restore the correct working length. With the high-speed machines of this class any disturbance of the running balance is a matter of serious moment, as the heavy vibrations are destructive of bearings and foundations. This balance depends on the hammers being equal in weight, which is not always a simple matter. To attain this end some of the heavy pattern castings are made with a chamber-cored hole through the head, as shown in Fig. 23, which can be filled with the required amount of lead to equalize the units forming the set.

Hammers vary in length, width, and thickness. Fig. 24 illustrates the heavy stub type fitted in the Mansfield granulators. These machines depend almost entirely on impact and are capable of giving a surprisingly good output when the heads of the hammers have almost disappeared.

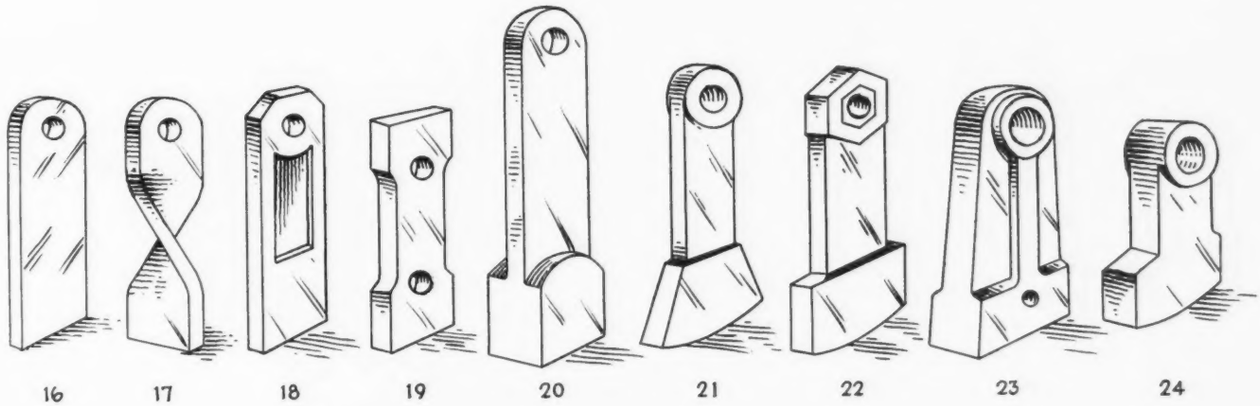
All the foregoing examples may be classed as straight-bar hammers. The second series comprises those of the U-shaped or stirrup pattern. The earliest example of the U-hammer was made from a square-rolled bar bent to the shape shown in Fig. 25, the projecting ends being turned to form the pivot pins. Two driving disks were fastened to the shaft and the hammers were secured by drawing the disks apart and inserting the pin ends into holes in the disk plates, which were then moved closer together and keyed in position. The sectional area of the square bar was limited, and this was afterward changed to a wide, flat plate shaped as shown in Fig. 26, the ends being drilled to take the attachment pins.

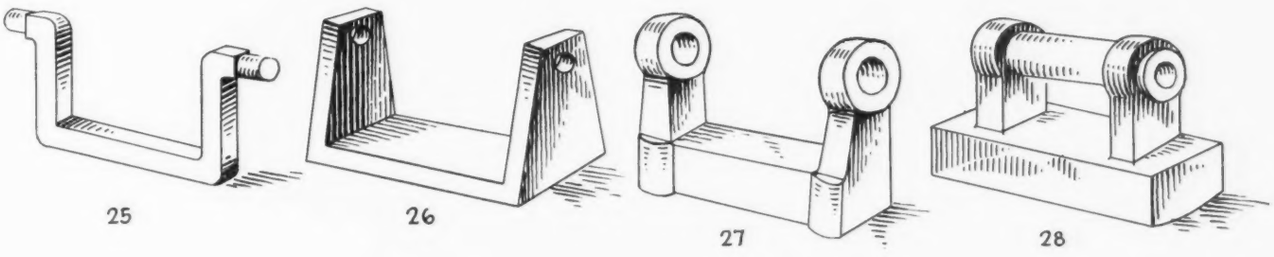
Figs. 27 and 28 represent stirrup hammers of English and Belgian make. These are castings of manganese steel. They are made of sufficient width to span the crushing chamber inside the wearing plates. These powerful hammers are useful conservers of energy and are capable of exerting a very heavy blow. They are exceptionally effective for dealing with hard and tough materials and for fine crushing. The machines, however, must be strongly built to withstand the inevitable shocks.

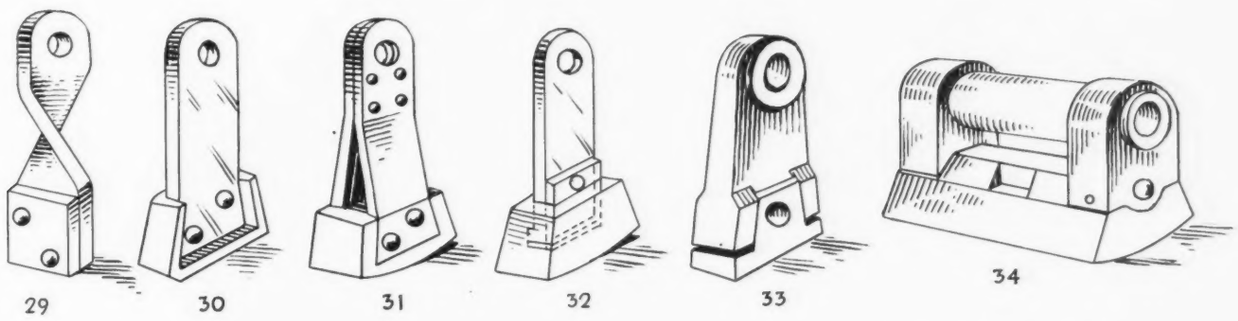
These wide hammers have a tendency to wear away more quickly close to the ends than in the middle, which is caused by extra friction from the side wearing plates, so the bulges shown in Fig. 27 have been added to compensate for this.

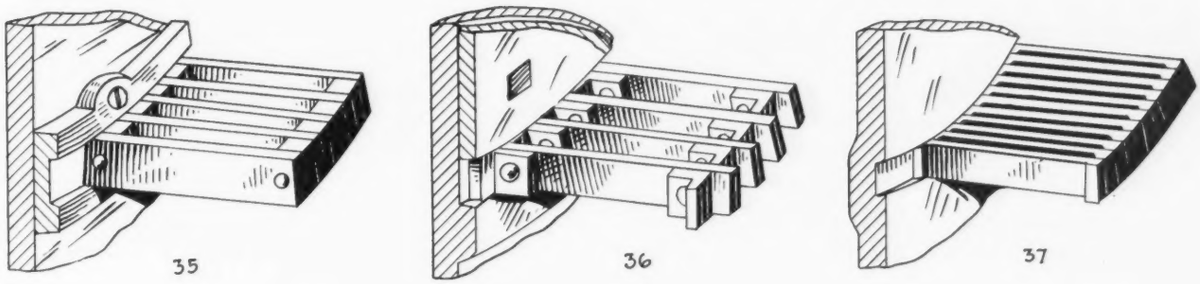
When comparing the merits of the straight-bar and stirrup hammers it is necessary to investigate the means adopted for securing these to the rotor. In most designs, where plain hammers are used the drum is composed of a series of disks assembled on the shaft. Sometimes the two end disks are heavy steel castings with thinner intermediate spacer plates of rolled steel; at others all the disks are castings of equal thickness. The hammer rods are threaded through the disks, which provide a series of supports for the bars and prevent deflection. They also serve to separate the hammers so that they can swing freely without striking each other. With narrow-faced hammers of equal thickness throughout, this arrangement gives a combined length of striking edge of approxi-

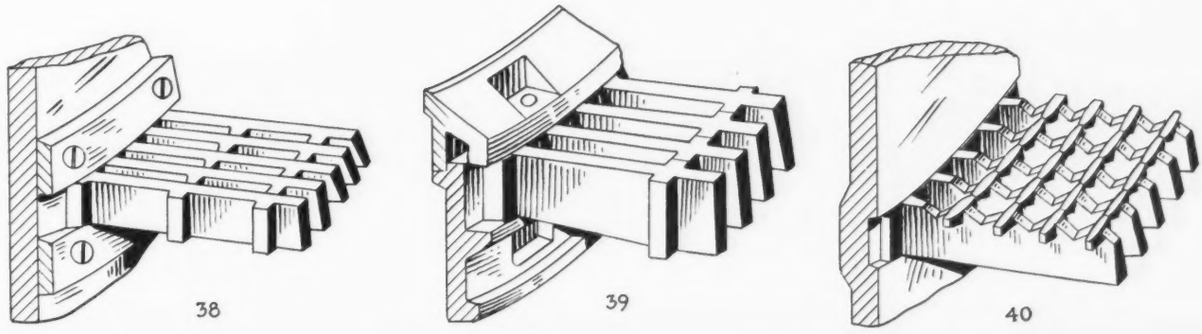
Figs. 16 to 40—Types of hammers and screen bars used in swing-hammer mills











mately half the full width inside the machine. By using stronger rods, reducing the number of disks, and threading the hammers as close together as possible, the weight and striking area of each row can be increased, or the hammer heads may be spread sideways until they almost meet.

The stirrup hammer sweeps the full width of the casing and, if it meets any impediment, it swings back, leaving the whole face clear, whereas in the row of multiple hammers only one or two may be affected, causing less disturbance to the crushing action. Wear and tear on the hammers is the heaviest item in the cost of maintenance, and many attempts have been made to devise some simple and effective system for securing renewable wearing tips.

The following examples will show some of the composite designs which have been tried from time to time. It is doubtful whether any of these have proved entirely satisfactory, but the end is not unattainable and the failures of today may lead to better things tomorrow.

Fig. 29 shows a twisted flat-bar beater with a renewable plate riveted to the striking face. The rivets are countersunk through the full thickness, but the fastening must be carefully watched as the plate becomes thinned by wear.

Fig. 30 illustrates a forged shank fitted with a cast head; the interior of the casting is dovetailed and the end of the bar is shaped to correspond so that the connection does not depend entirely on the rivets. The mass of this composite hammer is not equally balanced on either side of the center line and there is some tendency for the hole to wear unevenly.

The design shown in Fig. 31 gives a better-balanced hammer, but some difficulty is experienced in making sure that each side bar is a tight fit in its dovetailed recess. If there is the slightest initial slackness, the racking and twisting strains that result from the continuous hammering will quickly enlarge the clearance until the head is quite loose on the body.

Rivets are unsatisfactory as a means for securing the renewable piece to the shank. Fig. 32 shows an alternative system, including a wedge connection for this purpose. The cast head is chambered to receive the end of the link or handle, which has a projecting lip engaging a recess at the bottom of the cavity, thereby preventing the head from flying off the shank. A flat wedge of equal width is driven into the space to lock the bar in position. A hammer of this type in service on hard stone has to withstand many and varied stresses and strains. The tendency to fly outward under the influence of centrifugal force is counteracted at the moment of impact by an impulse forcing the head down the shank. Then again a broad-faced hammer may strike cornerwise with a deflecting blow, causing a twisting action on the head. No rough-fitting faces are capable of withstanding this combination of forces for any great length of time.

Fig. 33 shows a heavy hammer with a reasonable end piece having wedge-shaped projections on either side. Retaining lugs are cast on both sides of the block and the tip is driven tight into the recesses and secured by a single rivet. To insure interchangeability of parts, the bedding surfaces must be machined or ground to templet.

A stirrup hammer in two sections is illustrated in Fig. 34. The head is attached to the body by a coupling rod or hinge pin, which passes through the central projection and enters the holes in the side bars. The coupling bar is held in place by a cotter pin at one end.

The types of the screen bars are equally as varied as the designs for the hammers, and it is hardly possible to illustrate more than a few examples of the patterns used in hammer mills for crushing stone. Cage bars are usually supported in curved recesses in the side plates and, in most designs, are inserted as separate bars, although, in some instances, a number may be riveted together to form a section of the cage as shown in Fig. 35. The grating is made from rolled bars of rectangular cross-section, which are cut to length and assembled with intermediate spacer blocks of suitable shape to give the necessary screen opening and maintain the correct camber on the ends of the grate. When larger apertures are required small sections of angle iron may be used as spacers, as shown in Fig. 36, and if the bars are of any considerable length it is advisable to provide intermediate projections to prevent deflection. With this system of construction the bars are separate and held together by a locking plate or wedge block at one end of the cage. The rectangular bars do not give sufficient clearance when laid fairly close together side by side on a curve of moderate radius. If the screen openings are narrow on the inside of the cage they increase very slightly on the outside and the material becomes wedged in the apertures and so clogs the machine. Under these conditions the bars should be made with taper sides so that the opening increases rapidly, giving free passage to the outlet. Fig. 37 shows this type of bar built into a narrow grid. When rolled sections are used, the spacers are formed by spot-welding projections on the ends and afterward machine-grinding to size, or the bars may be made as castings of manganese steel. This latter material is commonly used when the bars are of sufficient size. Fig. 38 indicates the shape usually adopted for light work and moderate width of screen opening. The alloy is ductile instead of being brittle-hard, and is therefore particularly well suited to resist the shocks inseparable from work of this kind, but the bars require to be well supported laterally to eliminate bending.

When wide cages are necessary the grids should be made deeper at the center than at the ends, to effect a more economical distribution of the material. Fig. 39 illustrates this form of bar with projections on both sides.

Fig. 40 shows the cage bars used in the Gannow crushers in conjunction with the hammers illustrated in Fig. 21. Originally these machines were built with circumferential screen apertures in line with the path of the hammers, and the sweeping movement along the full length of each screen-slot was effective in preventing clogging. It was found extremely difficult, however, to maintain the spacing, as the wedging action caused local spreading, which closed the adjacent slots, and eventually the circumferential bars were replaced by cross bars of the pattern indicated in the figure with V-shaped notches forming a continuous track for each ring of hammers.

As previously stated, the swing-hammer crusher has the advantage of making a large reduction in a single operation on certain classes of material. In this respect it is superior to the reciprocating crushers. It is also capable of giving large tonnage outputs. Some of the big machines set for coarser products are reducing at the rate of 300 to 400 tons per hour.

The size of the finished product may be changed by varying the peripheral speed of the hammers, or by altering the setting of the breaker plates and screen bars, and a number of adjustments are available to meet special circumstances. Power required will vary with the character of the material, the percentage of moisture, the

extent of the reduction, and the speed of the crusher.

When dealing with any abrasive material, the cost of upkeep is high. Some manufacturers figure that if the silica content exceeds 10 per cent, the hammer crusher is inadmissible. Although this is not an absolute guide, the nature of the material should be carefully studied before installing a machine of this type.

Stone mixed with clay, or which becomes semi-plastic under bad weather conditions, is likely to clog the feed chute and impede or suspend operations, but this is not an insuperable difficulty, and special machines are built for work of this kind.

In some instances the users experience considerable difficulty in holding the swing-hammer crusher on its foundation. It is essential that a perfect running balance should be attained, or the vibrations will cause the machine to walk off its bed.

As in the case of all other plants of this nature, the final decision regarding the type of machine which should be adopted for any specific purpose should be left to the expert, but the foregoing remarks may prove of interest to engineers who use hammer mills or who are seeking a machine for some particular duty which falls within the scope of the swing-hammer crusher.

Mining With Filled Stopes

PART I, SUPPORTED METHODS

By CHARLES A. MITKE

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IN THE PREVIOUS ARTICLE, an important subdivision of "supporting methods"—viz., "open stopes"—was taken up and discussed. In this paper, "filled stopes," another division of supported methods, will be considered.

If surface subsidence and underground caving are to be avoided in orebodies where the ore itself, and the surrounding country, are not sufficiently firm to stand (either alone or aided by some sort of support used in open-stope methods), then waste filling must be placed in the stopes as the work of extraction progresses. The result of this operation is known as a *filled stope.*

Though no definite figures are available as to the exact tonnage mined by filled methods, it may be said that whereas probably the larger amount of ore, the world over, is mined by open-stope methods, a very considerable quantity is produced from filled methods.

Filled stopes, in general, are known as high-cost methods, and are, therefore, applicable only to the higher-grade ores, or where caving must be prevented. In exceptional operations these methods have been so modified as to permit their use in fairly low-grade material, but in such instances the ground is particularly well adapted to the fill method and allows the use of many expedients in eliminating hand labor, thereby reducing the cost. Where ground is heavy, and close filling must be practiced, only small openings being left for the men to work in, the filled method becomes a very high-cost system. On the other hand, if a considerable amount of ground can be taken out before filling is put in, most of the ore can be handled by gravity and stoping carried on quite cheaply.

The filled-stope methods, especially the square-set and cut-and-fill, are particularly adapted to irregular orebodies. Prospecting can be prosecuted in almost any direction as the stope progresses. In this way, stringers of ore are frequently followed which lead to other orebodies. In some mines more ore is found by following "leads," or stringers in stopes, than by level drifting.

Where waste occurs with the ore it may be sorted out and left in the stope as fill. This, with the additional waste from development, in many instances, is enough to keep the stope filled, without bringing waste from surface. However, if sufficient waste is not obtained from these sources, a double mining operation becomes necessary. First the ore is mined and drawn out through chutes into mine cars on the level below; then waste, which has been mined on surface or at some point outside the orebody, is turned into the empty cavity or stope from above.

With the fill methods, while preparations are being made to mine the ore, plans must also be under way to provide sufficient waste fill when it is needed.

There are three important types of *filled stopes,* as follows:

- **Underground Stoping Methods**
  - Supported stopes
    - Open stopes (Hard rock methods)
    - Filled stopes
      - Square-set
      - Cut-and-fill
      - Shrinkage-with-fill

In the square-set method, the ore is extracted in small blocks in the form of squares, usually 5 ft. x 5 ft. x 8 ft., the last figure being the height of the square.

The cut-and-fill, as the name implies, consists in taking off a cut of ground, usually 5 ft. high and from 5 ft. to 30 ft. wide, the length depending on the length of the stope. After the ground cut is broken and removed filling is added.

In the shrinkage with subsequent filling, the shrinkage stope is carried up in a manner similar to that described in a previous paper. This method is applicable where the walls and back of the stope are strong enough to stand without support until all the ore has been drawn out of the stope, when waste filling is added.

Of the three methods described, the square-set requires the most timber; the cut-and-fill, a smaller quantity; and the shrinkage with subsequent filling, the least amount. The timber is used merely to protect the miners from falling rock during the process of stoping and to hold the ground open temporarily, until filling can be added. Timber is also used for chutes and manways.

The different forms of timber support used in min-

ing are known as "sets." There are a number of different kinds of sets, such as "shaft sets," "drift sets," "raise sets," "stope sets," and others. It is with the stope sets that this paper is chiefly concerned.

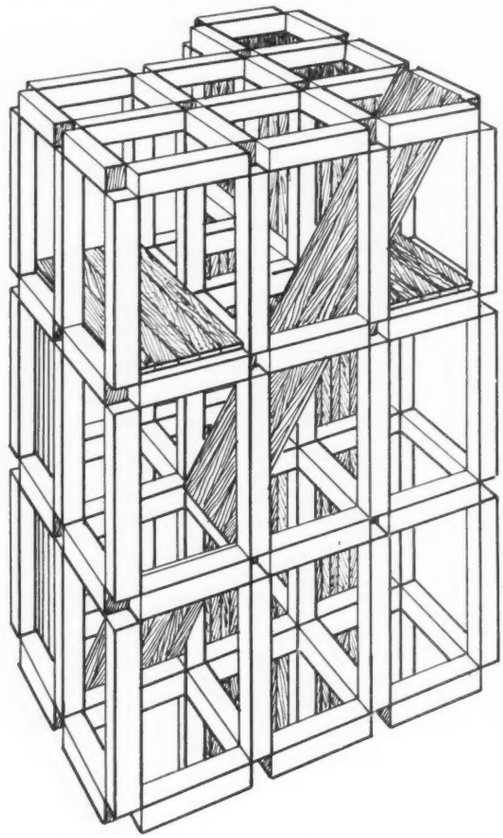


Fig. 1—A 2x3-set section of square-set stoping

A *square set* is that form of stope support in which timbered posts are set up at the corners of a square, the sides of which are, of course, equal, although the height may vary. The sides of a square set, between the posts, are usually timbered with light-weight material, called "lagging." General custom sanctions the use of heavy supports at each corner of the square, known as "posts," with caps and ties above to support the back.

The character of stope support used in the *cut-and-fill* method consists principally of occasional "umbrella stulls," with lagging on the sides of stopes, and square-set timbering at the chutes and manways.

In the *shrinkage with subsequent fill method,* either with or without pillars, cribbed chutes and manways are used, with only an occasional stull in the stope itself.

The waste filling is used to prevent the surrounding ground from caving. This is the *only sure method of supporting weak ground permanently.* Though waste fill settles from 2 ft. to 10 ft. between levels 100 ft. apart, this settling may be greatly reduced by mixing a certain quantity of water and fines (or tailings) with the waste rock. Reductions in settling down to only 2 in., and sometimes down to nothing, have been effected in this manner. At the No. 3 mine at Ray, Ariz., an irregular, relatively high-grade section of the orebody, extending under the creek bed, was satisfactorily mined out in 1921, by a square-set-and-fill method, without disturbing the ore bins at No. 2 Mine or opening cracks through which the flood waters from the creek might fill the mine. The method adopted was as follows:

"A section, two sets wide and eight sets long, is carried up from one level to the next, or to the top of the ore, and then the space is filled with waste. As a rule, sufficient waste to fill the stopes is obtained from development work in the three mines, but if, for any reason, the supply is short, capping, drawn from a finished stope in No. 2 mine, is used.

"The ore and capping are friable and cave readily. To keep the capping from cracking, the filling must completely fill the openings. Undue settling of the filling is prevented by flushing sand in at the top of the stope to fill the interstices in the waste. This is done as soon as a stope is finished. Also, sand may be run in while the stope is being filled. (A mixture of approximately two-thirds waste rock and one-third sand, or tailings, with water, is used.) The worked-out stopes are carefully watched, and if the filling settles, more sand is used at the top to keep the openings tightly packed. The sand used, which has about the fineness of ordinary building sand, is tailings from the company's concentrator at Hayden, and is brought to the mine in ore cars on the return trip. The dry sand is dumped from the ore cars into a separate raise and trammed by hand in one-ton mine cars to the top of the stopes. After being emptied from the mine cars, the sand is flushed into the stopes by means of a hose. Water for this purpose is piped from the pump column in the shaft; the small amount used readily drains through the filling to the level below and finds its way back to the sump for the mine pump. The water is clear after leaving the stopes. No bulkheads are used at the bottom of the stopes, as not enough water is used at any one time to create a hazard if held back. The mine is divided into sections by concrete bulkheads for protection against flood waters from the surface."[1]

The three major types of *filled stopes* have many variations as follows:—

- **Supported Methods**
  - **Filled stopes** (Used where no surface or underground subsidence is permitted)
    - Square set (For soft ore and soft walls)
      - Horizontal Square set. Used at: Butte, Mont.; Coeur d'Alene, Idaho; El Oro, Mexico; Mother Lode, Calif.
      - Square set with slides, or timbered rill. Used at: Cerro de Pasco, Peru; some stopes in Bisbee and Globe, Ariz.; Butte, Mont.; Burma, India.
      - Combined overhand square setting and underhand pillar work (Mitchell stoping method.) Used at: Magma Copper Company; few stopes at Calumet & Arizona Mining Company, Bisbee, Ariz.
    - Cut and fill (For medium ground)
      - Horizontal Used at: Nacozari and Pachuca, Mexico; United Verde Copper Company, Jerome, Ariz.; Painesdale, Mich.
      - Inclined, or untimbered rill. Used at: Calumet & Arizona Mining Company, Bisbee, Ariz.
    - Shrinkage with subsequent fill (For harder ores and firm walls)
      - With pillars. Used at: Homestake, Lead, S. D.; New Jersey Zinc, Franklin, N. J. Pillars reclaimed with slicing.)
      - Without pillars. Used at: Porcupine, Canada; Cananea; Leadville, Colo.

Square setting is a very important method. Approximately 80 per cent of the entire ore produced from the Butte camps is mined by some modification of this method. About 95 per cent of the Cœur d'Alene ore is extracted in this manner; 60 per cent of the ore in the Mother Lode mines in California; 95 per cent of the

[1]Reports of Investigations, Bureau of Mines, January, 1921.

United Verde Extension ore in Jerome; 40 per cent of the Copper Queen underground ore in Bisbee; 90 per cent of the Cerro Hill division output, of the Cerro de Pasco in Peru; approximately 60 per cent of the ore from the Bawdin mines, India; 100 per cent in the Arizona Commercial at Globe, Ariz. (timbered rill) and, until recently, 100 per cent of the Magma Copper Company ore in Superior (Mitchell stoping method). In addition about 20 per cent of the ore in Pachuca; 50 per cent of El Oro, Mexico; and 20 per cent of the Greene-Cananea ores are mined by this method.

In the development of a square-set stope, a small unit of ground is excavated, which will allow the setting up of a framework of timber, approximately 5 ft. x 5 ft. x 8 ft., the last named being the vertical dimension. As soon as one or more blocks of ground have been removed, timbered square sets are put up in the open spaces. The timbers used for corner posts in the square set are generally 8x8 in., and lagging of 2x6 in. is used between the corner posts (being nailed outside the posts) to wall up the sides. In heavy ground, 10x10-in. timbers are used, and in still heavier ground, sometimes 12x12 in. are used. The pressure exerted from any direction is taken up by the timber. It is very important, therefore, to block the sets tight against the ground, *to prevent a cave from starting.*

The dimensions of a square-set unit, or block, as previously mentioned, are usually 5 ft. x 5 ft. x 8 ft., and it contains 200 cu.ft., or, as an illustration, approximately twenty tons of heavy sulphide ore, or sixteen tons of limestone ore.

A number of these units are required to make a square-set section. As new units are being opened up and timbered, fill is put into the older ones and the process is continued until the entire block of ground is mined out. In nearly all instances the square sets are started at the level and carried up, and in only exceptional operations do they proceed downward.

After an orebody is thoroughly developed by drifts and raises, so that its limits are known, and the ore is found to extend for several hundred feet vertically, stoping operations are begun directly above the first level which penetrates the ore and are carried from that point to the top of the orebody. After the ore has been stoped down clean to this level, operations are started on the next level beneath and stoping is carried up approximately 100 ft. to the first level.

In general, sets are built horizontally the entire width of the ore which it is intended to extract by this method, then a second tier is begun above the first, then a third, and so on—efforts being made to have the square-set structure so planned that as large a percentage of the ore as possible will run by gravity.

Fig. 1 shows a 2x3 set section; that is, two units wide and three units long. The stope is progressing upward; that is, other units are being built on top of the original 2x3 set, so that the illustration looks very much like the skeleton of an incomplete three-story building. Two sets are generally maintained open for use as raise sets—one for the chute and the other for manway and timber compartment. Formerly, it was the custom to reserve very few sets for raises, and larger sections, from approximately 8x8 to 12x12 sets, were used. The latter section would cover an area of 144 sets, each 5 ft. x 5 ft. It was found too expensive to carry stope sections so large, on account of the hand shoveling and extra tramming in stopes, as well as the danger from caves that resulted through the opening up of too much ground. In recent years, the small section with many raises has been found safer and more economical, and the cost per ton is less than with the older system.

In medium ground requiring the regular timber, sections of 4x4 to 6x6 sets are usually taken. In these, 8x8-in. timbers are used. Close filling is not necessary, and larger sections are therefore permitted.

Heavy ground requires close filling, small sections, and large timbers. Sections usually range from 2x2 sets to 2x10 sets, and timbers 10x10 in. to 12x12 in. are used.

Nearly all square-set stopes (probably 95 per cent) are carried upward, which is generally known as "overhand," the rest being carried downward, by what is called the "underhand" method. The operations are very much alike, except that they are carried in reverse order. Underhand square setting is used where old caves in heavy ground are being mined out, which would require excessive spiling if carried upward.

The general size of timbers used in each instance is approximately the same. However, there is a small difference in the framing of posts used in "underhand," as compared to "overhand," square setting.

In heavy ground, square setting is usually carried on the horizontal; that is, the sets of ore are broken down

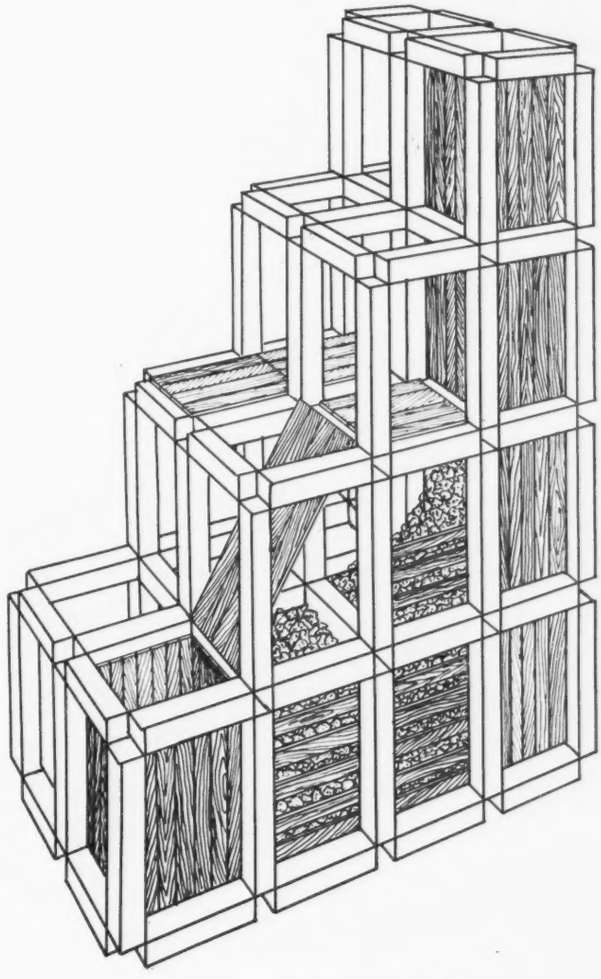


Fig. 2—Square set with slides, or rill stope

on a horizontal floor, whence they are shoveled by hand into a raise, or into wheelbarrows or small cars, and trammed short distances to raises. The reason for this hand work in heavy stopes is that it permits of a little

closer filling than would be possible if slides were used. In filling by hand it is only necessary to have two sets open vertically at a time, whereas, if the ore is handled by gravity (with slides or rill stoping), three or four open sets vertically are necessary, to allow the ore to slide to the raises from the extreme ends of the stoping section.

In this timbered-rill method, the square sets are carried up much in the same manner as in the horizontal method, except that timbered floors or slides are used in ground that does not need to be filled quite so close, where three to five open sets can be maintained vertically without filling. In Fig. 2 the slides may be seen. All ore has been extracted, the sets have been completed, and filling has been started. The slides are usually carried at an angle of 33 to 40 deg.

In developing a section of square setting with slides, the stopes are carried out to the central raise at one end

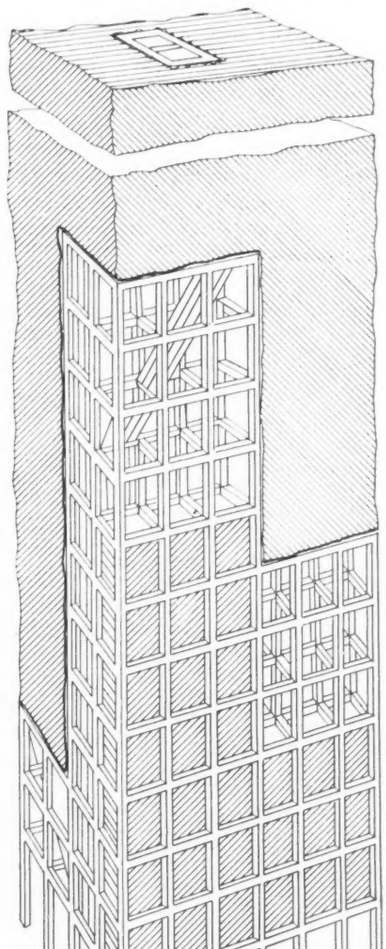


Fig. 3—Four sections of square-set stoping, illustrating method of carrying up sections

but at the other end resemble a stairway (see Fig. 2) —that is, each tier of square sets, as the stope proceeds upward, has fewer completed sets than the tier below, and the lower tiers are always completely mined out and finished before the tier above. This is done so that the ore from the upper sets may be run by gravity down the slide (on the left side of the drawing) while waste is run in through the chute (on the right side). The chute, or raise, on the right side of the stope is first driven through from one level to another to provide for waste fill, ventilation, and to lower supplies into the stope. At the extreme left are two sets, one the manway and the other the chute. The slide is shown down which the ore passes into the chute compartment on the left. These two sets are carried upward as the stope progresses, and will be used to carry waste fill for the section of stoping to be begun later at the left. Thus, in this small stope, while production is going on and ore is being blasted and broken on top of the slide, the chute on the right is frequently so arranged that waste is simultaneously being run in.

In Fig. 3 a block of ore is illustrated which is mined with four 2x3 set sections. All sections are worked from the central raise, which was first put up through the block of ore. The first section of 2x3 sets shown in this drawing is eleven sets high. It shows that slides have been used for the extraction of the ore. The lower seven sets have already been filled with waste, and the upper four are now producing and will soon be filled. Section 2, to the right of Section 1, is up six sets, and is being filled with waste. Section 3, which is on the left of the first section, is up only two floors and is in the production stage; and Section 4, which cannot be seen because it is in the rear of the block, is merely being prepared for stoping. By planning, one section may be kept producing while the other is being filled with waste.

Such an arrangement of four sections, close together, is used only where the ore is quite firm, and would not be suitable for heavy ground.

The rill stope with square-set timbering and the square set with slides are the same in principle. When the square set with slides is used in narrow veins it is called "timbered rill," in some districts.

The general mining cost, where square-set stoping is employed, ranges from $4 to $6 a ton. By the use of a number of expedients this can be materially reduced. One mine has lowered its total underground cost during the last year from $4.50 to $3 a ton by introducing a number of the following improvements:

1. Introduction of standard chutes. It has been found that a man can build a standard chute in very much less time than a special chute.
2. Using many chutes, instead of one or two, when starting new stopes. This saves hand shoveling.
3. The frequent use of from three to six grizzly chutes in stopes, where clean ore can be blasted directly into chutes. This saves wheelbarrow work.
4. The use of slides in stopes wherever practicable.
5. More general use of standard timbering, which eliminates cutting timber underground.
6. Careful selection of men, and placing them where they are best fitted, which makes for greater efficiency.
7. Careful sorting in stopes, especially in mixed ores.
8. Use of storage-battery motors for distributing waste, so that stopes can be filled quickly, thus preventing them from becoming heavy.
9. Providing ample storage for waste, in order to have sufficient filling available to avoid delays.
10. Carrying up raises and manways with old stope sections, which may be used for starting points in the newer stopes instead of driving separate raises.
11. Leaving in the sill floor, and starting stoping on the second floor, thus preventing the extraction drifts from becoming heavy and requiring unusual repairs.

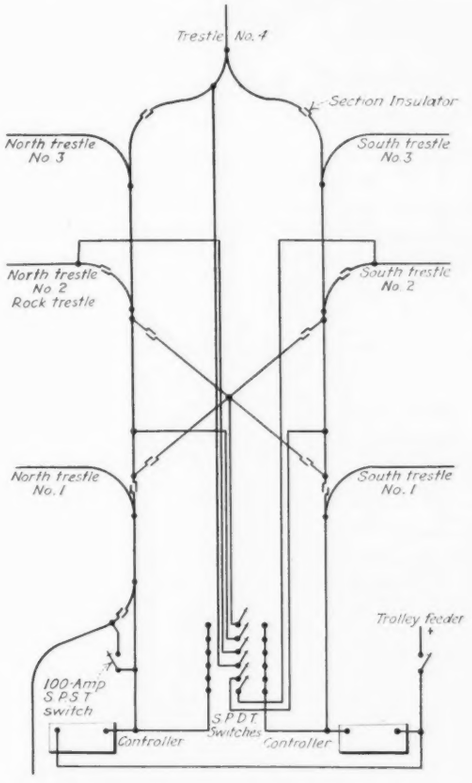
(To be continued)

Useful Operating Ideas

Remote Electric Control on Stockpile

By M. L. Dezendorf

AN UNUSUAL labor-saving arrangement of electrical apparatus employing remote-control equipment is used at the Ironton mine of the Corrigan, McKinney Steel Co., at Bessemer, Mich. Electrically operated cars move backward and forward over the stockpile trestle without anyone riding them. Dumping is automatic.



Stockpile trestle trolley layout. Remote electric control reduces labor cost in this transportation system

The trestle over the stockpile is divided into seven branches, each having its own track system, automatic latches, and trolley circuit. Two remotely controlled cars, each driven by two 10-hp. direct-current motors, carry the ore from the shaft bins to any desired point along the trestles. The cars are fitted with a series solenoid which applies its brakes whenever power is turned off the motors. Each car is also equipped with a reversing contactor which changes the direction of motion each time power is applied. By this means, if a car is traveling in a given direction, it may be reversed by first cutting off power and then by again applying energy to the motors. This arrangement for controlling the direction of travel is made definite and safe by a system of electrical and mechanical interlocks.

The cars are always under the control of one man who is in a control room near the head of the shaft. Here he manipulates drum controllers which apply power to a trolley consisting of 12-lb. rails suspended over the cars. Power is taken by the cars through a sliding shoe which makes a pressure contact against the trolley. The trolley rail is supported at 40-ft. intervals by arches made of wood, which assist in insulating the current from the steel structure of the trestle. Sag in the trolley is taken up by a messenger wire which is pulled tightly at each end. This method of providing support for the trolley results in a level overhead system.

No. 1 north and south branches near the shaft can be used by only one car with the present track layout; the remaining trestles can be used by either car. It is necessary only to operate the proper switches in the control room to direct either car over any section of track leading to or from the various trestles. One controller regulates car movements on one side of the stockpile track system and another takes care of those on the other side.

Cars dump automatically when they reach a tripping device which unlatches the doors. Pressure of the ore opens the doors. When the cars run back over the tripping mechanism the weight of the doors locks the latch, and the cars return to the loading chute.

Besides obviating the necessity for much labor, the electric, remotely controlled system makes it possible to carry on the dumping operation with the same speed, regularity, and safety in all kinds of weather.

Maintenance of Mine Motor Insulation

By James Silberstein
Wilkinsburg, Pa.

THE insulation is one of the most vital parts of the electric motor. Efficiency can be considerably increased and the life of the motor measurably prolonged if proper care is taken of the insulation.

Motors which have been idle for an extended period without heat to prevent the accumulation of moisture, or which may have become wet by accident, should be dried out thoroughly before being operated again. The most effective method is to pass current through the windings, using a voltage low enough to be safe for the winding in its moist condition. For 550-volt motors 50 volts is generally satisfactory. Thermometers should be placed on the windings to determine the temperatures, which should not exceed 190 deg. F. Applying the heat internally in this manner drives out all moisture and is particularly effective on mine motors where the insulation is comparatively thick.

Heat may also be applied externally by placing heating units around or in the machine, covering the whole with canvas or some other material and leaving a hole at the top to permit the hot moisture-containing air to escape. It is important that there be a circulation of warm air over all the surfaces to be dried, and the heaters should be so placed and baffles so arranged as to get a natural draft.

The time required for drying insulation out completely depends on the voltage and size of the motor. Insulation resistance measurements should be taken at intervals of about five hours until a fairly constant value is reached. This value should at least equal the following standard

$$\text{Megohms} = \frac{\text{Voltage}}{\text{Kva.} + 1{,}000}$$

The insulation resistance of motors in good condition is considerably higher than this value.

Because abrasive dust cuts the insulation, when carried through by the ventilating air, a systematic and

periodic inspection of motors is necessary to insure best operation and prolong the life. To clean them, the motors can be blown out, using low-pressure, dry, compressed air (at about 10 to 15 lb. per square inch). Suction is to be preferred, however, because damage can be caused by blowing the dust into the insulation.

When oiling or greasing bearings, excess lubricant should not be applied, as it is likely to be carried into the motor, where it catches dirt and abrasive dust and thus promotes failure of the insulation.

Grease and oil are easily removed by applying cleaning liquids like gasoline, naphtha, or carbon tetrachloride. These liquids evaporate rapidly, and, if not applied too generously, they will not soak the insulation. Carbon tetrachloride is especially recommended, as it is non-inflammable. Though the insulation will dry quickly at ordinary room temperature after cleaning, it is desirable to heat to promote drying and drive off all moisture. Varnish is then applied and baked on at about 210 deg. F. for from five to seven hours. If the machine must be put back in service quickly, good results will be obtained by applying one of the quick-drying varnishes. Insulation-resistance readings should then be taken to determine whether the winding is in satisfactory condition. After the tests it is good practice to run the motor without load for a short time to make sure that everything has been assembled and adjusted properly.

Separating Dross From Mercury Squeezed From Amalgam

By C. S. Anderson

AMALGAMATORS in small mills who have to clean and squeeze amalgam by hand are usually bothered by a dross that forms on top of the mercury thus squeezed out. Generally this dross is skimmed off with the thumb or fingers to brighten the surface of the mercury. In handling an ore containing antimony and arsenic in the metallic state I was confronted with an unusual amount of dross floating on the mercury, and had to spend much time in skimming the mercury during the daily clean-up. To eliminate this operation, the simple device described below was made. It proved entirely practical in use.

The top of a quicksilver flask was sawed off. On the side near the bottom of the flask a hole was drilled and tapped to take a ½-in. pipe, the center of the hole being about ½ in. above the bottom. A close nipple was screwed in the hole. Next a circular piece was cut from stovepipe iron of a diameter to fit in a ½-in. union. In the center of the disk a hole of 1 mm. diameter was drilled. The disk was placed in the union and the two halves were screwed together. The union was then screwed on the nipple.

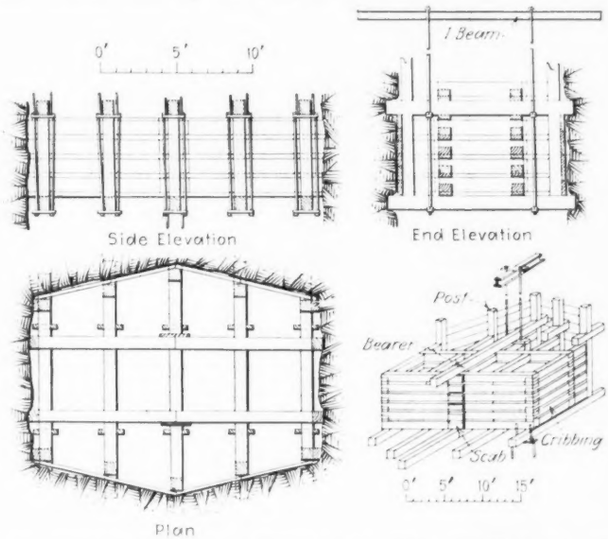
In practice, the quicksilver squeezed from the amalgam is poured into the flask, and the mercury which issues in a fine stream is caught in a vessel partly filled with cyanide solution. The purpose of this solution is to prevent spattering and to assist in cleaning the mercury. When the flask is nearly empty, the dross remains with a small amount of mercury in the bottom of the flask.

The dross and mercury thus obtained can be saved from day to day until enough has accumulated for cleaning by retorting. If retorted at as low a temperature as possible clean mercury with a small amount of impure sponge bullion is produced. If bullion is melted into bars this sponge is melted with the regular melt. If sponge bullion is shipped, the impure bullion may be placed with amalgam to be retorted.

The Walker Method of Shaft Timbering

By Carl Trischka

"IT CAN'T BE DONE" was the verdict of some when it was proposed to deepen the Denn shaft at Bisbee, Ariz., but Joe Walker, manager of the Shattuck-Denn Mining Co., devised methods for overcoming the difficulty. The ground from the 1,800 to the 1,975 level was soft, much broken up, swelling, and wet. Ordinary timbering was tried, but did not last at all. It was found that by sinking in such a manner that the



One method of shaft timbering in soft, swelling ground

bottom was 10 to 15 ft. in advance of the ordinary timbering and then following this up by the Walker method, replacing the ordinary timbering, a strong, substantial and lasting construction resulted. The accompanying illustration gives the general layout and indicates the reason for its success. Arching prevents crushing.

I-beams were laid across the shaft on solid footings and were the first bearer sets. From them were suspended wooden 10 by 12-in. heavier sets every 5 ft. The shaft timbers, in the form of cribbing, were placed on these sets as shown. All timber was carefully blocked. This is important, as is also the requirement that all bearer sets be placed on solid ground. Two almost independent sets of timbering units are the result. Replacements and adjustments are easily made to either without disturbing the other. Accessibility to do this adjusting or repairing is good.

Although this is a somewhat costly method, it was successful and obviated the possibility of sinking a new shaft. The same method had been used in the shaft higher up for 25 or 30 ft. of similar ground which had given a great deal of trouble for a year or more. Though this timbering was placed two years ago, only minor adjustments have been made.

An important feature is the lagging against the posts. It should be made of lighter material than the posts so that it will break before the posts yield. All that is necessary to do is to ease the ground and replace the broken lagging.

DISCUSSION

An Opportunity for Local Mining Associations

THE EDITOR:

Sir—A visitor in our reading room calls attention to the editorial in your Nov. 5 issue headed "An Opportunity for Local Mining Associations." Though the Northwest Mining Association is not exactly "local"—it covers Montana, Idaho, Washington, Oregon, British Columbia, Alaska, and the Yukon—it has maintained for a number of years a service such as you declare to be desirable.

We frequently receive inquiries from the East as to the operations and prospects of companies in sections as distant as Arizona and the Black Hills, and answer these to the best of our ability or else reply that the concern is so far away that we have no information available.

We never advise any inquirer to invest in a specific property, but we occasionally advise one *not* to invest in a concern that is obviously fraudulent, such as certain tin and platinum promotions that have lately been attempted. We also direct attention to misstatements and exaggerations in promotional literature, and co-operate with the state and federal authorities (and the provincial authorities in Canada) in their efforts to hold mine promoters within bounds.

The extent of our investigations may be gaged by the fact that the State Mine Inspector of Idaho dropped into our office a few weeks ago, and in two hours learned about six companies operating in his own state, at least three of them selling stock, of whose existence he had not previously been aware. (He made this statement himself in an interview in the daily *Spokane Spokesman-Review.*)

In the Northwest, with the exception of Oregon, there are no drastic blue-sky laws to hamper development of natural resources, which is recognized as a speculative enterprise. The comparative freedom of this section from legislative interference is due largely to the fact that the Northwest Mining Association will not countenance deceit or misrepresentation in the marketing of mining securities, and that it commands means of publicity to stop improper practices even when state laws sometimes fail.

The association recently held its 33d annual banquet, which attracted mining men from Butte, Seattle, central Idaho, northern British Columbia, and various sections in between. It is now preparing for its 33d convention, which will be held in February or March; and among its activities for 1928 which have been added to the normal program will be the compilation of a Northwest Mines Handbook covering, in greater detail than a world-wide handbook can, the mining operations in its particular field.

The bulk of inquiries received deal not with dividend-paying stocks, but with those of development companies listed on the New York Curb or Western exchanges, or of new companies engaged in financing prospects. Sometimes such an inquiry is the first intimation we have that a company is in existence, and occasionally our own letter of inquiry to a state official is the first knowledge he has of its operations.

For instance: An inquiry came from Minnesota to a chamber of commerce in Idaho regarding a company reputed to be operating a gold mine in that state. The chamber of commerce referred the matter to this office; we wrote both to the Minnesota inquirer and to the State Mine Inspector, with whom all mining companies are required by law to file information prior to conducting mining operations. That official had never heard of the company, but from Minnesota came the information that the stock was listed on the Montreal Mining Exchange, and the names of the officers. One of these names being recognized, we wrote to the publisher of the county-seat newspaper in his home county. The publisher likewise had never heard of the concern, but started inquiring, and in a few days—

1. The inquirer in Minnesota had his information.
2. The State Mine Inspector had his documents.
3. The county-seat newspaper had a news story.
4. The mining company (incorporated in Delaware) was saved from inadvertently violating an Idaho law.
5. Our files were "up to date."

In that way the Northwest Mining Association is serving the industry and the investing public, and the growing volume of correspondence reaching this office indicates that, in the words of your editorial, it "might easily attain a national reputation and thus attract a considerable amount of money for mining investments in the territory it represents."

LEON STARMONT,
Secretary, Northwest Mining Association.
Spokane, Wash.

* * * *

The Bounds of Known Science

THE EDITOR:

Sir—I have been much interested in Dr. Mason's "Geophysical Exploration for Ores," concluded in your last issue, and in your editorial "Geophysics and Spiritualism." I would like to inquire who, if anyone, among physicists has taken the pains to study any of the electrical or other exploration methods, thought to be "entirely outside the bounds of known science," and made records of their conclusions and the processes by which they were reached. If this has not been done to any considerable extent, might not an exhaustive and critical study of such methods yield at least a few grains of truth which science might profit richly by—and now regarded "outside its bounds"? Is not science still in its infancy?

Only once in my life have I seen water located by a "switch" (forked twig). It was done within five minutes and even the depth given within a foot. Though a single

instance proves nothing, such a performance makes one feel that the matter is worth looking into—and not to be ignored as worthless "doodle-bugery."

If you chance to know of a few references to papers by investigators of this general subject, I will be much pleased to have same. A. B. Bibbins.

Baltimore, Md.

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Principles of Geophysical Prospecting

The Editor:

Sir—In the issue of Oct. 8, Mr. Theodor Zuschlag comments on my article entitled "Principles of Geophysical Prospecting," and takes exception to the implication that direct current exploration has greater all-around efficiency than alternating current. What he says is, in fact, that inductive methods are superior to potential ones. To prove his contention, Mr. Zuschlag first excepts from consideration the "spontaneous polarization" method. This is equivalent to saying that, to prove the excellence of a process, we will entirely ignore essential and unique possibilities of the other ones. Further comment on that point is unnecessary. However, for the sake of argument, let the discussion be confined to artificially created fields.

Mr. Zuschlag then attempts to show that the method creating an electric field by grounding a source of electric current is decidedly inferior to that creating an inductive secondary field. The use of an inductive field is limited strictly to the study of metallic conductors. To obtain a secondary electro-magnetic field, it is necessary to have a secondary current generated within the body of a metallic conductor. This method is therefore *not* applicable to the general study of stratigraphic and structural problems.

Since the application of Mr. Zuschlag's methods does not draw him into this tremendously important phase of geophysical prospecting, he again ignores a vital part of the work that can be and *is being* performed with potential methods.

Further discussion of the matter is impossible until he puts into a more convincing form the bases of his contentions and objections. I must frankly admit that the story of his "dead component" is not clear and that I do not understand its significance. Furthermore, to anybody knowing by experience the practical difficulties of experimental physics a "dead component" present in or absent from a formula does not mean much. Facts and observed phenomena, which are unfortunately always more complicated than theoretically expected, must be brought into the discussion. There are always discrepancies between formulas and accomplishments.

Ordinarily, a method is good because the errors are simple, small, or infrequent. In this connection, nothing is simpler than d.c. potential methods, which give concrete expression to only one property of the formations studied—namely, their conductivities. Inductive methods are obliged at the same time to take into consideration conductivity, capacity, and induction of the rocks. Each of those factors plays an unpredictable rôle, which does not conform to simple, ideal cases. This complication of the results is a serious weakness of the inductive methods, which, in addition as already pointed out, are limited to the study of metallic conductors. Another weakness is the difficulty of the interpretation of even the simplest results. Sherwin F. Kelly.

New York.

"What Is Engineering?"

The Editor:

Sir—"Engineering is the act of solving problems concerned with, and the practical application and direction of, the physical and mechanical forces and materials of nature in construction and to the use of man.

"Mining engineering is engineering directed to the solution of problems concerned with, and its application to, recovery and beneficiation of natural mineral resources."

I submit the preceding, having followed the discussion of the subject for some time and having read the *E. & M. J.* of Nov. 5, in which reference is made under the title quoted above. I was affected by the mental impression that the definition submitted by the committee, almost if not quite, limited itself to mining engineering: " . . . *utilization* of the resources of nature for the *use* of man." (The italics are mine.) The amended form is open to the same criticism.

Before we can specialize on the definition of an "engineer," we must arrive at a fundamental definition of "engineering." What are the tools of the engineer? Answer: Physics, mechanics, and materials, together with the scientific laws which govern and their interrelations.

When we have a fundamental definition for engineering it will be less difficult to define "What is an engineer?" For example: mining, electrical, steam, and hydraulic engineer.

I am suggesting a definition also for geological engineering as follows:

"Geological engineering is engineering applied to the solution of problems concerned with the rock formations of the earth and associated mineral and ore deposits, their physical features, discovery, and utilization."

Helena, Mont. Leverett S. Ropes.

* * * *

Licensing of Engineers

The Editor:

Sir—The question of whether to support or oppose the licensing of engineers in Wisconsin is being studied by a committee of the Engineering Society of Wisconsin, of which I am chairman. The committee is open-minded and anxious to reach a sound conclusion. Our study of published discussion reveals a lack of concrete and specific evidence upon which to base judgment. The committee desires, therefore, to get in touch with anyone who has something tangible to offer. We would like especially to learn about the merits and defects of licensing from individual engineers who are working under license laws. Perhaps some of your readers will have something to offer. Here are some of the questions we ask:

Are there *quacks* in the engineering profession; that is, are there men who do not possess a passable knowledge of mathematics, physics, and mechanics, but who, nevertheless, pass themselves off for engineers? Does anyone know of specific cases of quackery?

Has licensing, where introduced, actually and tangibly improved conditions for either the public or the engineer?

Has licensing, where introduced, adversely affected the condition of the engineer, either by imposing an appreciable financial burden, hampering free movement from state to state, imposing a barrier to worthy young men who want to enter the profession, or in any other way?

College of Engineering, L. F. Van Hagan.

Madison, Wis.

NEWS OF THE WEEK

Summary

BUDGET submitted to Congress carries increased appropriations for mining investigations, accident work, and economic studies. Total amount allowed the Bureau of Mines, however, represents a decrease of $413,070.

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Phelps Dodge Corporation considers the erection of an electrolytic copper refinery in the West; 580 acres have been optioned near El Paso, Tex., as a possible site, but alternative locations at several other cities are also under consideration.

* * *

H. P. Whitney interests purchase the Flin Flon property, in northern Manitoba and Saskatchewan. Developed ore reserves are estimated at 18,000,000 tons, with a recoverable value of $8.50 per ton.

* * *

Department of State begins negotiations with the Chilean government concerning proposed taxes on fuel imports, which taxes are opposed by American mining companies operating in Chile.

* * *

Trading on Standard Stock and Mining Exchange in Toronto continues to increase, and another new record was established on Nov. 22, when 3,989,212 shares were traded.

* * *

Apparently no effort will be made at the present session of Congress to consider a revision of mining laws, although a strong demand exists in the West for such action.

* * *

Further progress is made by Ambassador Morrow and Mexican officials in settling matters in dispute between the two countries.

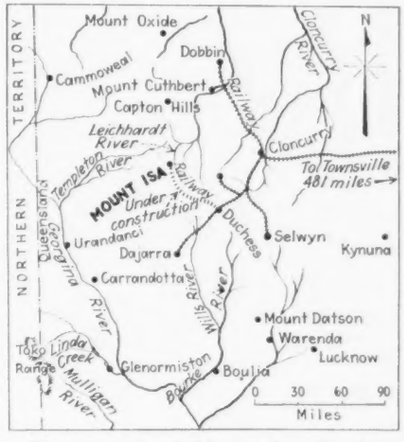
Left—Open cut on western side of Racecourse outcrop. Right—The Even Break open cut.

Russo-Asiatic Proceeds With Development Work at Mount Isa

Drilling Operations Receive Most Attention at Present—Erection of Pilot Mill to Begin Soon—Railroad Line to Property One-third Completed

THE Russo-Asiatic Consolidated, Ltd., is proceeding steadily with development and drilling operations at the Mount Isa property in Queensland, Australia. About 80 men are at work on five of the groups of mines, the majority of them being engaged in drilling operations. Erection of a pilot mill of commercial capacity is expected to be started soon. The railway under construction from the property to Duchess is making fair progress, being about one-third completed. Toward the end of October, five new sets of drilling equipment were received from England. These are being used to test the deposits to a depth of 500 ft. Previous drilling did not extend beyond a depth of 300 ft. from the surface. Development operations continue in the northern end of the Black Star mine, where a series of shafts are being sunk to a depth of 100 ft. for the purpose of exploring the deposit at this point. Open-cut operations will be used in mining this section of the lode.

As to the amenability of the ores to treatment: Early in 1927 quantities of representative carbonate and sulphide ores from the mines were sent to London and New York for treatment tests.



Sketch map of Mount Isa district

Preliminary tests made last June proved that the ore was amenable to treatment. A report has recently been received by

Upper left—Mount Isa outcrop at southern end of Black Star lode looking west.
Lower left—Black Rock lease, showing face of eastern escarpment.
Upper right—The first camp at Mount Isa; outcrop in background
Lower right—Southern end of Black Star lode, looking south

the Mount Isa company that the final tests, which have just been completed, gave results that are definite and exceptionally good, demonstrating that the ores are capable of being treated by a simple and profitable method. At the same time the directors stated that Mount Isa Mines, Ltd., and the Russo-Asiatic Consolidated, Ltd., had jointly taken an option on 400 acres adjoining the Mount Isa leases on the west, and into which it is believed the lodes proved in those leases extend. It is intended to explore this new area thoroughly by diamond drilling.

Mount Isa Township is on the Leichhardt River, the bed of which is usually dry the greater part of the year. During these dry periods, what are locally known as "soaks" must be depended on for a water supply; however, as a result of good rains recently, enough water is available to last the community for some months. A small experimental dam, which was built for the purpose of testing the runoff of the watershed area of the region, is full, and to a limited extent will supplement the supply from ordinary sources. A plan is under consideration for providing a permanent water supply for both the township and the mines. This plan involves the construction of a dam on Rifle Creek, a tributary of the Leichhardt, 20 miles up the river, from which point the water will flow by gravity to the populated center and to the mines.

The Mount Isa deposits are in Queensland's Cloncurry western district, over 500 miles from the northern port of Townsville. The prominent outcrops of the orebodies were discovered in 1923. Among the first to secure leases on the new field was W. H. Corbould, who, having been for eight years general manager for the Mount Elliott company, operating copper mines in the same district, had a good knowledge of the extensive Cloncurry mineral field. He became promoter of the present Mount Isa company. Another company, holding a number of leases adjoining on the south and some smaller flotations, afterward came into existence, but it was recognized almost from the first that the big lodes that had been disclosed could be worked economically only as a unit. Subsequently, therefore, the companies in the district were merged to form the Mount Isa Mines, Ltd., which now holds all the operative mines on the field.

Over two years ago the chief government geologist of Queensland, B. Dunstan, who had twice examined the field, estimated that the silver-lead ore reserves of four of the largest mines in the area represented a gross value of £16,000,000. Among the principal mines, the Black Star, although having a low average value, was credited with the greatest quantity of ore, which was estimated to be 3,560,000 tons, worth £11,370,000. The Black Rock mine, with the smallest tonnage, was said to have a high assay value, averaging 25 per cent lead and 12 oz. of silver per ton. The value of the Black Rock ore reserves was placed at £3,000,000 and those of the Rio Grande were valued at £1,500,000. In further reference to the Black Star lode, Mr. Dunstan said: "The magnitude of this occurrence is brought home when it is remembered that it exhibits the greatest average width of pay ore (200 ft.) of any known lode of commercial possibilities in the Australian commonwealth, and it has a continuous length of over a third of a mile. The Broken Hill orebody in New South Wales, though 1¼ miles in length, has an average width of not more than half that."

Mount Isa is about 60 miles from Duchess, the nearest point of the railway connecting the Cloncurry district with Townsville; and, mainly on Mr. Dunstan's testimony, the state government, to bridge this gap, started the Mount Isa-Duchess branch line.

Mount Isa Mines, Ltd., having proved its properties by exploratory work sufficiently to warrant heavy additional expenditure, needed capital for further development operations, to equip efficiently its mines and to construct a treatment plant. After unsuccessful negotiations with the Anglo-American Corporation of South Africa the company concluded arrangements last June with Russo-Asiatic Consolidated, Ltd., whereby the latter agreed to provide £550,000 by taking up Mount Isa company £1 shares to that amount, receiving also an option for two years over a further 200,000 shares at £2 each. The corporation also received 50,000 bonus shares as an underwriting commission. The nominal capital of the Mount Isa company is £1,500,000. Russo-Asiatic, having obtained a controlling interest, under the agreement, appointed three men[illegible] to the Mount Isa board of directors — namely, Leslie Urquhart, chairman; C. J. C. Scott, deputy chairman of the Russo-Asiatic; and C. A. R. Scott. Three of the six members of the Mount Isa directorate retired, including W. H. Corbould, who had been managing director of the company, but who, on his retirement, was appointed advisory director and remained in London for a time to consult with the technical staff of Russo-Asiatic Consolidated. The Mount Isa company is to remain Australian, with headquarters in Sydney, and, though the nomination of chairman rests with the Russo-Asiatic, the former occupant of that position continues as chairman of the newly constituted board.

Before the Russo-Asiatic Consolidated decided to find the required extra capital and take control, the position of the Mount Isa mines, as at the close of 1926, was that underground development work to an average vertical depth of 200 ft. had reasonably proved about 4,000,000 tons of carbonate ores, and that the promise which had been held out by developments had been confirmed by the results of the first diamond-drill holes completed into the sulphide zone on the Rio Grande and Black Star orebodies.

When the Anglo-American Corporation of South Africa declined to exercise the option which it had taken over Mount Isa shares, it was admitted that the values and sizes of the Mount Isa deposits were all that had been represented, and that it was not any doubt in this respect that had influenced the corporation's decision.

More Mill Construction in Joplin-Miami District

CONSTRUCTION of a tailing mill and a flotation plant are to be undertaken in the near future by the Missouri-Kansas Zinc Corporation, according to C. Erb Wuensch, consulting engineer of the property, who made the announcement recently on returning to the Joplin-Miami field after a trip to New York, where the headquarters of the corporation are situated. To finance the improvements, the company plans to sell privately a block of 10,000 shares of capital stock. It has 100,000 shares outstanding, about 11,000 of which are now held by the public. The company some months ago paid $850,000 cash for the holdings of L. P. Buchanan, of Joplin, and approximately $300,000 cash and stock for the holdings of the Barnsdall Mining Company, located in the Waco, Mo., section of the Joplin-Miami field. Bonds to the extent of $1,400,000 have been sold by the company. It is planned to convert the Barnsdall No. 3 mill into a tailing mill as soon as a surface tram is built from the Barnsdall No. 13 and from the Barnsdall No. 3 mines to the Acme mill. Ore from the Acme and the two Barnsdall mines will then be treated at the Acme mill.

It is understood that an arrangement has practically been completed in the Joplin-Miami field whereby the Federal Mining & Smelting Company will acquire the Tar Creek mine of Fred Childress and associates. The purchase price will approximate $75,000. The Tar Creek mill recently burned, after having been built to replace a mill burned earlier in the year. It is the plan of the Federal company to work the Tar Creek mine ore over the Muncie mill, on the adjoining 40 acres. The arrangement was brought about by J. B. Porter, of Joplin.

The Domado Lead & Zinc Company has purchased the Kitty mine, west of Cardin, Okla. No publicity was given to the consideration, but it is understood to have been around $150,000. The Kitty was owned by R. L. Kidner and associates, of Kansas City. The Domado company was given a drilling option on the property some months ago, and has proved up a satisfactory orebody. Domado owns the Jack and Jill mine, in the same neighborhood, but the mill at that property will be converted into a tailing mill in the near future, according to Charles A. Neal, manager of the Domado company.

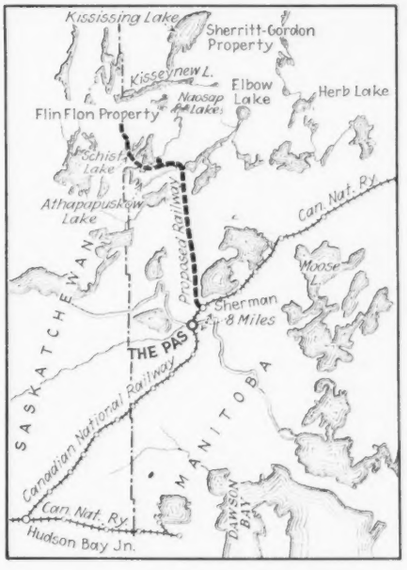
Diamond and Excelsior Mines Under New Control

It is reported that George F. Stott, superintendent for the Eureka-Holly company for several years prior to its closing down about six months ago, has transferred his option on the Diamond and Excelsior mines, in the Eureka, (Nev.) district, to the United States Smelting, Refining & Mining Company.

H. P. Whitney Interests Purchase the Flin Flon Property

Contract Let for 85-Mile Railroad—To Erect Flotation Unit, Copper Smelter, and Electrolytic Zinc Plant at Mine—Developed Ore Estimated at 18,000,000 Tons

ON NOV. 30, the H. P. Whitney interests, of New York City, exercised their option to purchase the Flin Flon property, in northern Manitoba and Saskatchewan. The Mining Corporation of Canada, Ltd., under the terms of the option retained a 15 per cent interest in the property and received payment in full of the purchase money, amounting to $854,000. The David and Alec Fasken holdings in the property were also purchased by the Whitney interests, giving them an 85 per cent ownership of the entire property. Following this action, the Whitney organization transferred a 35 per cent interest to the Newmont Mining Corporation, of New York City. The Dominion government has granted for a period of twenty years an exemption of royalty payments on production from ores occurring in Manitoba. Negotiations are still pending concerning such payments on production from Saskatchewan ores.



Sketch map of Flin Flon district, showing proposed railway

Contracts have already been let to the Dominion Construction Company and the Tomlinson Construction Company, of Toronto and Winnipeg, respectively, for the construction of the 85-mile railroad into the property from Sherman, 8 miles northeast of The Pas on the Canadian National Railway (see above sketch map.) Preparations for the establishment of the construction camp at the Flin Flon mine by these companies will start next week, and within four weeks about 500 men will be engaged on the work. The estimated cost of this branch line is $3,500,000. On completion it will be operated by the Canadian National Railways. The Province of Manitoba has agreed to make payments not exceeding $100,000 a year for a period of five years, to cover any deficit in the operation of the road during that period; the Whitney interests will contribute $250,000 toward its cost.

The construction program of the Whitney syndicate includes the erection of a flotation unit, copper smelter, and electrolytic zinc plant at the Flin Flon property. A separate corporation will be formed to build a 270,000 hp. hydroelectric plant at White Mud Falls, 162 miles east of the property. This corporation will sell power not only to Flin Flon but also to other mines in the district.

Drilling and development have been progressing steadily at Flin Flon. Shafts have been sunk to a depth of 400 ft., and during the last ten months considerable crosscutting, drifting, and stoping has been done on this level. Ore reserves, based on development and diamond drilling to a depth of 900 ft. below the surface, are estimated at 18,000,000 tons with a recoverable value of $8.50 per ton. The deposit, which is an irregular lens-shaped body of massive sulphides containing copper, zinc, gold, and silver, has a maximum width at the surface of 250 ft. and an average width of 125 ft. Ore at the 900 ft. point is equally as good as that in the upper workings. Although the size of the orebody has not been definitely determined, present indications are that further development will show continuation at depth and extensions along the strike. A pilot mill has been in operation at the property since last March.

A large portion of the deposit will be mined by steam shovel from an open pit and the remainder by large shrinkage stopes. All the ore will be treated by flotation in a mill with an initial capacity of 3,000 tons per day and producing a copper concentrate, which will be smelted in reverberatory furnaces, converted to blister copper and shipped; and a zinc concentrate, which will be treated in the electrolytic zinc plant. Current operations on the property are under the direction of R. E. Phelan.

Receiver Named for Idaho Copper Company

On petition of the Boise Association of Credit Men, a receiver was named on Nov. 26 for the Idaho Copper Company, controlling the Red Lodge and South Peacock mines in Idaho and the Iron Dyke mine, in Oregon.

Bodies of Two Men Still Missing in Magma Mine Fire

Zeno Daley, an Apache Indian, Returns From Safety to Aid Comrades and Loses His Life—Mine Rescue Crew From Globe-Miami Station Leads Search for Entrapped Miners

AT THE time of the last report, the bodies of two men had not been found of the seven killed on Nov. 24 in the No. 2 shaft fire at the Magma Copper Company's mine at Superior, Ariz. A second fire, also of unknown origin, broke out three days later near the surface in No. 1 shaft, but there was no loss of life and only slight damage.

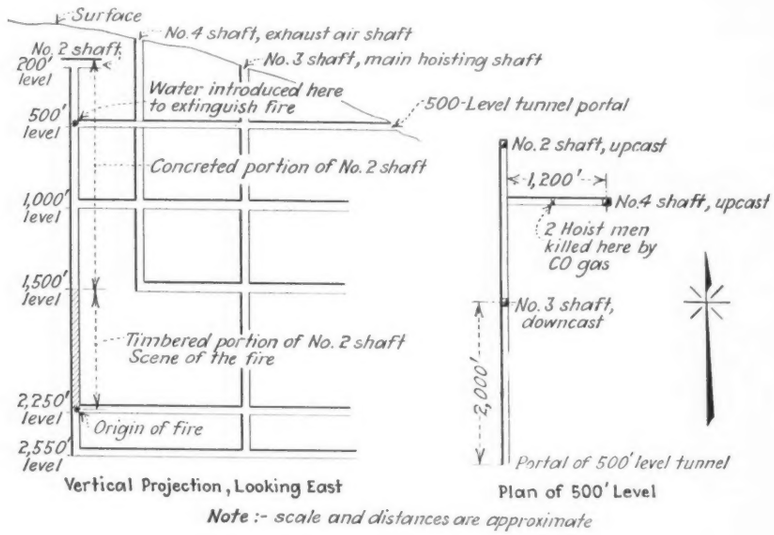
No. 2 shaft, the scene of the disastrous fire on Thanksgiving Day, is lined with concrete above the 1,600 level, but from the 1,600 to the 2,250 level the shaft is timbered, and it was this timber which caught fire from an unknown cause at 4 a.m. The fire was discovered by men at work deepening the shaft who noticed cinders falling down upon them. A crew of only 50 men was at work in the mine, it being the "graveyard" shift, which starts at 8 p.m. and ends at 4 a.m. Forty-three of these men left the mine safely through No. 3 shaft. The dead are: John McMahon, an American; Juan Branbila, Mexican; Sam Maki, Finn; A. Rintla; Finn; E. Olmas, Mexican; R. Rodriguez, Mexican; and Zeno Daley, an Apache Indian. Daley gave his life in a heroic attempt to rescue the others. He was among those who reached a place of safety, but returned to the fire zone in the No. 2 shaft cage to assist his comrades to safety. The fire melted the hoisting cable, and the cage with Daley in it dropped to the bottom of the shaft.

The bodies of McMahon and Branbila were found on the 500 level between No. 4 and No. 3 shafts. They comprised the hoist crew on the 500 level of No. 4 shaft and were evidently attempting to reach No. 3 shaft when they were overcome by carbon monoxide gas. No. 4 shaft extends to the surface, but has been stripped to serve as an upcast air shaft. To use this shaft as a means of reaching safety was therefore impossible. The body of E. Olmas was found on the 1,500 level of No. 2 shaft, and the bodies of Maki and Rintla on the 900 level of No. 4. The bodies of Daley and Rodriguez have not been found.

Soon after the fire started it was thought that some of the seven men might be found alive in the raises and sublevels between the 1,000 and 1,500 levels where there was a possibility of the air remaining pure. Hope for them, however, was soon abandoned when the actual gas conditions underground became known.

A crew of eighteen helmet men from the Globe-Miami mine rescue station, headed by Director Orr Woodburn, reported at the mine soon after the fire began and led the search for the men trapped by the fire. By flooding the shaft with water from the 500 level, the fire was extinguished at 10 p.m. the same day. The fire zone is shown in the accompanying sketch.

On Friday, the following day, the mill was operated on ore from the storage bins, and, as the mine had been almost cleared of gas, it was planned to resume mining operations soon, the ore being hoisted through No. 3 shaft, which was not affected by the fire. This program was interrupted by the fire in No. 1 shaft, three days later, which endangered the lives of 50 men and interrupted the search for the bodies of the two men missing in the Thanksgiving Day fire. A few minutes after this second alarm was sounded, however, the 50 men reached the surface safely.



Sketch showing fire zone

As in the first fire, the cause of the No. 1 shaft fire was not determined. One explanation offered was to the effect that combustible gases from the fire in No. 2 shaft, which burned uncontrolled for more than twelve hours, might have seeped through the drifts to No. 1 shaft and been ignited.

An accurate estimate of the damage done by the two fires has not been made, but it is probable that the total loss will reach nearly $500,000.

American Companies Oppose Chilean Taxes on Fuel

Informal discussions with the government of Chile concerning the proposed taxes on foreign fuels which are aimed to create a demand for the use of Chilean coal are being carried on by the Department of State. The tax schedule specifies a rate of 3 pesos per ton for the first year, and an increase of 3 pesos each year thereafter until the seventh year, when the tax remains fixed at 21 pesos per ton.

American copper companies in Chile, which at present use oil, imported from California, in their smelters, have made representations to the Department of State because they would have to change much of their machinery in order to use the Chilean coal, which is of low grade. Moreover, transportation of coal up the mountains would be more difficult than transportation of oil. They are also concerned over the difficulty of obtaining a steady supply of coal, because of the danger of strikes among the miners. For these reasons they have requested the State Department to take up the matter with the Chilean government.

Hecla Sinking Main Shaft an Additional 800 Ft.

The Hecla Mining Company, of Wallace, Idaho, has started sinking its main shaft, the purpose being to extend it 800 ft. It is a vertical four-compartment shaft, and its present depth is 2,000 ft. Some three years ago the Hecla management, in order to prove the oreshoot at greater depth before extending the main shaft, sank another shaft or winze vertical and adjacent to the oreshoot, and about 1,600 ft. east of the main shaft on the 2,000 level. This new shaft was extended 800 ft. and crosscuts and drifts have proved the oreshoot practically the same as in the workings above and with no change in geological conditions.

While the new depth is being added to the main shaft, crosscuts and drifts will be run to connect with it on the 2,400 and 2,800 levels.

Copper Range Company's Mines Producing Steadily

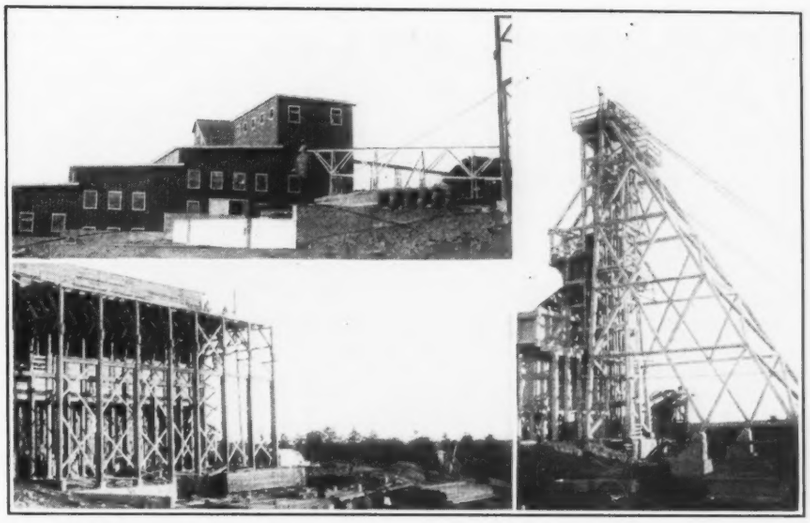
In the Michigan Copper District—Push Repairs in Quincy's No. 2 Shaft—New Station Cut at 87 Level

THE three mines of the Copper Range Company, in the Michigan copper district, are producing approximately 1,800,000 lb. of refined copper a month. At both the Trimountain and Baltic properties not much sinking or drifting is being done, attention being devoted principally to production. Openings are sufficient to permit mining. Only one shaft is being operated at each of these two properties, No. 2 at Trimountain and No. 3 at Baltic. As the result of this saving in overhead and cutting down of development work until the metal market strengthens, both of these mines now are a bit on the right side of the ledger. Champion, with three shafts in commission, Nos. 1, 3, and 4, continues to do well, both in yield per ton and in production. Extensive development is in progress throughout the mine.

At Quincy, no further opening of the rich East lode will be done until No. 2 shaft is again in operation. Repair of the fire and "air-blast" damage in this unit is making slow but steady progress. As retimbering proceeds, filling is being done wherever possible to strengthen the shaft and guard against further caving. The work is being pushed night and day. No. 6 shaft is giving a good account of itself in production. Both mass and vein rock, rich in copper, are being hoisted. A station is being cut for a new level at the 87, after which a crosscut will be started to the Pewabic series. This opening also will cut the new East lode, which, to date, has been but little developed in No. 6.

At Mayflower-Old Colony, the west crosscut from the 1,700 level of the shaft is now in 3,100 ft., with negative results. The crosscut is just entering another amygdaloid formation, but no copper is visible in the lode. There is still a considerable stretch of territory to explore, and the crosscut can be driven more than a quarter of a mile farther before the boundary is reached. The opening, which is through solid rock, requires no timbering and there is no difficulty with water.

At Arcadian Consolidated, copper values continue in the old Arcadian vein opened by a crosscut from the 1,250 level of the New Baltic shaft. Drifting is proceeding both north and south. The copper is finer than that occurring in the ore previously opened, but this variance in content is characteristic of the Lake lodes. Mineralization is heavy and fine by turns as the formation is opened, and frequently lean stretches are encountered. Veins also vary with depth. Arcadian plans to sink the New Baltic shaft several more levels and open both the New Baltic and Arcadian lodes in ground that is more settled. The present showing and prospects are considered the most encouraging in the history of the property.



Upper left—Present 300-ton mill at the Paymaster property. Lower left—New 1,500-ton concentrator under construction. Right—The new main shaft

New Concentrator at Paymaster Mine Ready to Operate Soon

AT THE Paymaster mine, in Porcupine, Ont., good progress is being made with the construction of a new 1,500-ton concentrator. Within the next two or three weeks the new building should be inclosed. Most of the machinery is already on the ground, and the plant should be ready to operate early in the new year.

The Paymaster is the most ambitious undertaking of its kind in northern Ontario, or, in fact, in Canada, as it plans to mine and treat an ore having an average grade of about $2.75 a ton. The ore occurs in the form of a porphyry intrusive, quite extensively mineralized. It is believed that the gold came up with the porphyry, which accounts for the very even distribution in mineralization. Near the walls, quartz stringers are found carrying very rich free gold, but these will only act as sweeteners and are not taken into consideration in figuring the average grade of the orebody.

For some time the company has had a 300-ton cyanide plant in operation, which is really being used as a sampling plant. With the completion of the new concentrator it will be used to treat the concentrates. The main shaft has been sunk to the 800 level, but practically all work has been confined to the 100, 200, and 300 levels, the main haulage being at 300 ft. Stopes are opened up across the orebody, which has a width of 100 ft.; the stopes will be 60 x 100 ft., with 30-ft. pillars. Each alternate pillar will be blank, the other pillar having a central raise from the 300 level to the surface. Sublevels are driven at 33-ft. intervals. A new system of stoping has been developed for this particular orebody.

Michigan Mines Save by Reduced Rail Rates on Coal

A large saving to Michigan consumers of Lake cargo coal from Southern fields will result if the Interstate Commerce Commission permits the voluntary reduction of 20c. per ton on rail shipments to Lake Erie ports to stand. The mining companies of the Michigan copper district are among those chiefly concerned in hearings now being held. The saving to Calumet & Hecla Consolidated alone would be $100,000 a year.

Consumers of Lake cargo coal in Michigan, Wisconsin, Minnesota, and North and South Dakota have organized the Northwest Lake-Cargo Consumers' Association for the purpose of procuring the proposed reduction of 20c. a ton on bituminous coal from Tennessee, Virginia, West Virginia, and Kentucky to Lake Erie ports for trans-shipment by water. James MacNaughton, president and general manager of Calumet & Hecla Consolidated, is president of the organization. Manufacturers, mining companies, and others in these states consume 20,000,000 tons of coal annually. They believe that coal from the South bears an unfair tariff as a result of a reduction last May in favor of Ohio and Pennsylvania coal.

Hearings were started by the Interstate Commerce Commission in Washington and resumed in Minneapolis on Nov. 29. The Northwest Consumers will appear before representatives of the commission in Minneapolis.

The State of Michigan also will officially request a sufficient rate cut to permit the roads serving the Southern fields to compete with the Pennsylvania and Ohio fields.

New Budget Carries Several Increased Appropriations

Higher Allotments for Mining Investigations, Accident Work, and Economic Studies—Total Amount Allowed the Bureau, However, Decreases $413,070

By Paul Wooton
Special Washington Correspondent

THE campaign of the mining industry and the activities of Senator Oddie looking to increased appropriations for the work of the Bureau of Mines have borne some fruit, as the budget just submitted to Congress carries increases aggregating $187,930, for mineral mining investigations, mine-accident work, economic studies, and for other purposes. Nevertheless the total amount allowed the Bureau shows a decrease of $413,070. The principal cut, however, is in the helium item, which is a service activity being performed for the Army and the Navy. Helium work is semi-secret in character, for military reasons, and it is presumed that the reduction of those expenditures from $1,063,000, during the past fiscal year, to $462,000 reflects some change of policy in connection with the production and conservation of helium.

Such increases as have been allowed are regarded by Senator Oddie as a step in the right direction, but still woefully inadequate. For investigations as to the causes of mine explosions, causes of falls of roof and coal, and safe methods of mining the budget carries $399,470. This is an increase of $13,000 over the amount available for this work during the current fiscal year. Though the budget does not show the subdivisions of the estimates, it is assumed that the increase is intended for studies of falls of roof and coal and for studies of electric equipment for use in coal mines. There has been an insistent demand for additional work in these fields of activity.

An increase of $15,000 is allowed for the investigation and improvement of mine rescue and first-aid methods and appliances and for the operation of mine rescue cars. No service in the Bureau is regarded as more vital to coal operators and mine workers. It is assumed that the increase will be devoted to an extension of the educational service performed in that connection. The Director of the Budget passed the proposal to purchase and equip a new mine rescue car at a cost of $45,000. This item does not figure in the increase, however, as the budget for the current year provided for the purchase of the car.

For scientific and technologic investigations, concerning the mining, preparation, treatment, and utilization of ores with a view to increasing economic development and efficiency, the new budget carries $125,000. This is an increase of $25,430 over the amount available under that head for the current fiscal year. As the Bureau has been doing some preliminary work looking to an investigation of geophysical methods of prospecting, it seems probable that a portion, at least, of that amount will be devoted to that purpose.

An increase of $75,000 has been allowed in the budget for oil shale investigation. The probabilities are that this means that those advocating a continuance of the operation of the oil shale plant in Colorado have been successful.

An increase of $50,000 in the item for the study of the economic problems of the mineral industries indicates that progress is being made in the organized effort of the technical societies and the individuals for the purpose of procuring greater co-operation by the federal government in such work, which includes reports as to uses, reserves, distribution, stocks, consumption, and prices of minerals. It will be recalled that the expansion of work of that character was urged also by the Reynders committee. Another small increase is allowed for the testing of fuels.

The fact that these increases have been recommended by the Bureau of the Budget does not mean that they will obtain the approval of the appropriations committees and of the House and Senate themselves. Substantial reductions frequently are made in Budget items. For that reason, Senator Oddie points out, there is every reason for the representatives of the industry to impress the need for additional funds on their Senators and Representatives, so that the full amount recommended may be retained and possible increases secured.

Revision of Mining Laws Improbable

Apparently no effort will be made at the coming session of Congress to consider the revision of the mining laws. Although it is admitted that there is a strong demand in the West for such revision, it is offset by the reluctance of many mine owners who have secured their titles under the existing code. They hesitate to give their support to a movement which would bring into being a new and untried set of laws. It is feared that it might confuse some of the issues which have been settled in court at great expense.

On the other hand, information reaching Washington indicates a gradual accretion to the ranks of those who favor vertical side lines. They argue that the experience in Canada and Mexico, as well as elsewhere, is ample proof that no great risk is involved in making this practice universal.

Decreased Production Expected in Tonopah Region

October Bullion Output Totals $140,865 —Treadwell-Yukon Develops Large Tonnage of Ore at 2-G Mine

OCTOBER bullion production in the Tonopah, Nev., mining district totaled $140,865 in value. Of this total the Tonopah Mining Company shipped $71,345, which includes its production and that of the Tonopah Belmont Development Company, as well as some miscellaneous custom ores. Tonopah Extension shipped $56,020, and West End Consolidated $13,500. The total of $140,865 is lower than that for September, which was $161,200, but the decreased tonnage from the Divide district in October, shipped to the custom mills of the Tonopah Mining Company and the West End Consolidated, makes the actual Tonopah production about the same. November will probably show a decrease, as the West End Consolidated closed its mill in October and is shipping only selected ore to the Tonopah Mining Company's plant at Millers.

Development work on the 700 level of the old 2-G mine, at Tybo, Nev., now under option to the Treadwell-Yukon Company, is opening a large tonnage of high-grade mill ore. It will be recalled that the 2-G was an important silver-lead producer in the early days of mining in Nevada, with a production record of around $5,000,000. Between the 300 and 400 levels the ore changed from a carbonate to sulphide character, and this, coupled with water troubles, finally resulted in a complete shutdown of the property. Several unsuccessful attempts had been made to reopen the mine, and large sums of money were expended for pumping and other equipment, before the Treadwell-Yukon Company became interested. This company, with W. H. Blackburn, as managing engineer, and Willard Hales, as superintendent, has sunk the vertical shaft to the 700 level and done about 2,000 ft. of cross-cutting and drifting on this level. Nearly all of the development was in the vein and a good portion of it in ore. Recent developments in the east drift, where the vein has widened to more than 25 ft. of solid sulphide ore, practically assure that the option on the property will be exercised and construction on a mill and possibly a smelter will be started within the next year.

Phelps Dodge May Erect Electrolytic Plant in West

Phelps Dodge Corporation has recently taken an option on 580 acres near El Paso, Tex., as a possible site for an electrolytic copper refinery. Alternative locations at one or two other cities are also under consideration. Nothing definite, however, according to the corporation, has as yet been decided in regard to actually constructing a plant in the West.

London Letter.

By W. A. Doman
Special Correspondent

Ammonia Consumption More Than Expected at Bwana M'Kubwa Plant

London, Nov. 21—Last week, in discussing Bwana M'Kubwa, the large sales of shares that had been made by directors of companies was mentioned as a fact which seemed to indicate loss of faith. Since then an opportunity occurred to talk over this matter with one of the parties interested. He justified the action of the various boards. They have to make profits for their shareholders, he said, and why should they not sell? Finance companies buy when shares are low and sell when they are high, and the fact that they do so does not affect the value of the property. This brings up another point; the low price of the shares. It seems as though something must be wrong, with prices where they are and with various adverse rumors in circulation. Inquiries about the metallurgical department of the business developed authoritative information that, as originally planned, the plant had not worked up to expectations. Instead of the consumption of ammonia being 1 lb. per ton, it had been as high as 5 lb., and delay was caused in endeavoring to discover the reason. The consumption is now down to 1½ lb. of ammonia, and this is about the minimum that can be expected. Copper in commercial amount it was stated, is in the mine, for in such ore as has been extracted the metallic content has always come up to sample.

ONE reason why output is small is that the middle of one lode, which is the richest part of it, has been taken out by the former owners, though this presumably was known when the present owners took over the property. The mine is being worked opencast down to the 350 level. At present two steam shovels are in operation, but a third shovel is on its way to the property, and should be contributing its quota by the end of January. In reply to an inquiry as to dissension in the management, the explanation received was that the dual control of the Minerals Separation in the metallurgical branch and of the Anglo-American Corporation in the technical department was not quite satisfactory, and it was thought best to put the whole management under the direction of the Anglo-American Corporation. Then, again, one of the managers was also connected with the Angola Diamond Mines, and it was decided that the magnitude of the Bwana M'Kubwa necessitated the constant attendance of an engineer, and not divided attention. Many shareholders have been disturbed at the rumors of a reorganization of the capital. The company has already spent about £2,000,000 on the property, and more money is needed. This, however, has been found without an appeal being made to the shareholders, the finance companies interested having subscribed among them about £200,000, which will enable operations to be carried on until next October, when the final stages of capitalization and work will receive attention.

It is credibly reported that certain American companies are endeavoring to secure a footing in the Rhodesian copper fields and have offered large sums of money to get a 50 per cent interest in some of the leading companies. This has been refused on the ground that if a 50 per cent interest were granted, additional shares could be bought on the market and the present control be taken over.

Recently, the output of the Lautaro Nitrate Company was mentioned. The Chilean Nitrate Committee here has received from the Nitrate Producers' Association, Valparaiso, a telegraphed translation of a letter from the Chilean Minister of Finance, to be circulated to nitrate producers and also sent to Berlin. The letter says that the Lautaro Company asked for new grounds—part of Pampa Nebraska — which contain 5,000,000 quintals of nitrate, so as to increase the annual production of Oficina Pena Grande to 400,000 quintals. The request has been granted The government, anticipating further inquiries, states that the factors governing its decision are the productive capacity of the petitioners, financial capacity, increase of production to be undertaken, present reserves of caliche, and royalty offered. The statement refers to Article 9 of Law No. 4,144 under which the president of the Chilean Republic may adopt measures for increasing production.

For the fortnight ended Oct. 31, the Nitrate Producers' Association sold 84,713 tons of nitrate of soda for delivery up to June next; 30,683 tons has been sold for shipment during the period of July-December, 1928.

Gold Production of New Guinea Announced

The last shipment of gold received in Sydney from the Edie Creek and Bulolo fields in the mandated New Guinea territory totaled 17,000 oz. of an average value of £2 5s. per ounce. J. D. McLean, the mining warden, is on a visit to Australia to confer with commonwealth ministers and officials in regard to new mining ordinances. He is greatly impressed with the resources of the field. So far, only the alluvial ground has been worked, and that in a primitive way. A large lode has been traced for a considerable area, but very little work has been done on it up to the present. The airplane service is giving satisfaction, six machines being in use. A large airplane to carry a load of one ton is being ordered from England. For the first six months of 1927 the output was 47,308 oz., valued at £101,227.

Melbourne Letter

By Peter G. Tait
Special Correspondent

Investors Turning Attention to Tin Deposits Found in Pilbarra Gold Field

Melbourne, Nov. 3—Australian and British investors are turning their attention to the tin deposits of the Pilbarra gold field, in the northwest of Western Australia. At Moolyella and Coogle-gong, where stream tin has been worked for years by fossickers and aborigines, a few tons of ore are sent in regularly every month. At these two centers, as well as the Old Shaw diggings, extensive areas have been taken up. Other centers attracting attention are Tabba Tabba and Wodgina. The district is served by the Port Hedland-Marble Bar Railway. Tin occurs both in the alluvial and lode, and the deposits are said to be very rich. One company has shipped an engine-driven "dryblower" to the Moolyella field, and it will be interesting to see how it fares. The district is not well watered, but with an adequate system of water conservation, hydraulic sluicing would be a more satisfactory method of treating the alluvial. Dr. E. S. Simpson, government mineralogist, recently visited the field, and has expressed a favorable opinion as to the prospects for systematic development.

ACTIVITY in alluvial tin mining in north Queensland still continues. Several companies are at work, and others are installing hydraulic sluicing plants. In addition, a number of areas are being prospected with a view to flotation. The recent drop in the price of tin, however, affects the attractiveness of such ventures.

At California Creek, California Creek Tin, Ltd., has been carrying on preliminary work with the hydraulic sluicing plant on the ground acquired by the company by purchase from the department of mines. E. C. Saint-Smith, government geologist, in reporting on values estimated the area of 110 acres to yield approximately 4 lb. of tin oxide per cubic yard, and the trial tests, so far as they have been carried out, confirm the estimate.

The Carbine Dredging Syndicate, holding approximately 3,000 acres of alluvial ground between Mounts Molloy and Carbine, is finding the depth of ground considerably greater than anticipated. The hand plant recently introduced was successful in putting down a test hole in the center of No. 1 area at Leichhardt Creek to a depth of 75 ft., when a boulder obstruction prevented continuance to bottom. Installation of a power plant is contemplated to test the deep ground. For the first 40 ft. in the test bore an overburden of granitic drift was encountered without value. From this point a bed of wash of 8 ft. gave a value of 2 lb. per cubic yard.

Toronto Letter

By Our Special Correspondent for Northern Ontario

Toronto Market Continues to Boil—Good Reports From Dome Mines

TORONTO, Nov. 26—The Toronto mining market continues to boil, and on Nov. 22 a new high record of trading was reached, when 3,989,212 shares changed hands. The volume for the ten days between Nov. 11 and Nov. 22 was over 31,000,000 shares. Since that time, however, the market has quieted to some extent, and there has been an orderly decline in the prices of most of the securities.

Good news continues to come from the Dome Mines, in Porcupine, but practically all of it is from unofficial sources. It is, however, definitely known that ore has been encountered on the 9, 10, and 11 levels. This ore is of good grade, and a substantial tonnage has already been proven. The output of the mine for the year has been better than expected, and, with the decrease in operating costs, substantial additions have been made to the cash surplus.

THE Ankerite Mines, of Porcupine, has recently been listed on the Standard Stock and Mining Exchange in Toronto. This company, which is controlled by the Porcupine Goldfields Development & Finance Company, has a capital of 2,000,000 shares of $1 par, of which 1,500,000 shares have been issued. The property is equipped with a 250-ton mill, which has treated to date 55,800 tons of ore for an average recovery of $5.80 a ton. It is believed that if the capacity of the mill can be further increased the company will be able to make a reasonable profit.

At the special shareholders' meeting of the Amulet Mines held in Montreal, Nov. 23, the bylaws proposed by the directors were unanimously confirmed. A feature of the meeting was the election of A. A. MacKay to the position of managing director. Mr. MacKay is a member of the mining firm of Alderson, MacKay & Armstrong, which has been intimately connected with the development of the Aldermac property in Rouyn and other properties in which Noah Timmins is interested. R. B. Popham continues to be president of the company. It is estimated that the present plans for financing operations will cover all necessary exploration and development expenses and the installation of a permanent mining plant, leaving a substantial balance toward the cost of a mill. The company's engineers state that as the extent of the orebodies has not been definitely determined, it is impossible as yet to make an estimate of the tonnage available, but development work on the No. 4 area so far has established the fact that there is an orebody 400 ft. long and 250 ft. deep, and that a crosscut at the 250 level has shown a width of 86 ft. The total length of the orebody is still unknown. A large number of diamond-drill intersections show good ore. It is understood that 60 per cent of the gross values are represented by zinc.

An official statement by the management of the Howey Gold Mines, in the Red Lake section, confirms the fact that commercial ore has been encountered on all four levels of the property. The crosscuts were run out under a diamond-drill hole which gave only fair results over a width of 6 ft. Drill holes located both to the east and west gave substantially higher results. No official statement has yet been made regarding the widths and mineralization on the two lower levels at 375 and 500 ft. The annual meeting will be held within the next few weeks, and it has been decided to leave any further announcement until after the annual meeting, as in the interval it should be possible to do 100 ft. of drifting on each level.

The official report of the Keeley Mines for the three months ended Oct. 31 shows a production of 201,869 oz. of silver. Early in the year the company was producing at the rate of 125,000 oz. of silver per month. The Keeley interests also control the Vipond mine, of Porcupine, and for the quarter ending Oct. 31, the official statement shows that 22,442 tons of ore was milled, the recovery being $154,000, or $7 per ton. Recent developments on the property have been more encouraging, the most important being the discovery of a high-grade oreshoot on the 300 level, which has been opened up for a length of 100 ft.

A new power house and headframe are being erected on the Waite-Ackerman-Montgomery property, in Rouyn, which is controlled by the Noranda. The shaft is down to a depth of only 40 ft., but it will be continued to the 200 level, where a crosscut will be driven to the ore about 300 ft. to the southeast. The property has approximately 300,000 tons of ore developed by diamond drilling, and will be in a position to ship to the Noranda plant as soon as Noranda is ready to receive it. It is probable, however, that shipments will have to await the completion of the concentrator which is to be built at the Horne property of Noranda Mines.

Lake Shore is installing another tube mill and two filters, which will increase the mill capacity 100 tons a day. At present the mill is handling between 700 and 750 tons a day. The new shaft is completed to 200 ft., and work has now been started on enlarging the raise below the 200 level to shaft size. When this is finished the company will have a shaft of much larger dimensions to the 1,000 level.

During October, the Sylvanite mill, in Kirkland, treated 200 tons a day and produced $71,000, the recovery being approximately $12 a ton. Costs were $5.20 a ton on ore milled, which shows a profit of about $40,000. November production is running at about the same rate as for October.

Mexico City Letter

BY W. L. VAIL
Special Correspondent

Further Progress Made by Ambassador Morrow and Mexican Officials

MEXICO CITY, Nov. 24—The decision of the Supreme Court of Mexico by a vote of nine to two, declaring unconstitutional the present regulations concerning oil ownership, is generally accepted as an indication that an understanding has at last been reached on a subject that has caused much friction between Mexico and the United States. An apparent willingness on the part of the Mexican government to make concessions toward a final agreement in settling the various questions in dispute is becoming evident. Mr. Morrow's personality appears to have overcome the Mexican reticence. If the assumption is correct that a general plan is being agreed upon for a regulation of differences, the mining interests operating in the country, will naturally be greatly benefited.

The new automobile road from the City of Mexico to the port of Acapulco, on the Pacific coast, 468 kilometers distant, has been formally opened and considerable tourist traffic is developing. One of the principal advantages of this new highway is that it will pass through a number of hitherto undeveloped mining sections. Quite a number of new denouncements have been made in sections of Guerrero in anticipation of the opening of the road.

ORES and metals exported from Tampico for the month of October show a considerable increase as compared with previous months. From a total of 31,451 tons in September, shipments increased to 52,768 tons in October. The principal items of export were zinc concentrates, calcinated zinc ore, and lead in bars. The tonnages of the various exports were: Lead in bars, 22,879; zinc concentrates, 20,065; calcinated zinc ores, 7,671; copper, 1,725; arsenic, 263; antimony, 165.

Zinc concentrates and zinc calcinated ore were exported to Antwerp and Dunkirk, about 85 per cent to the former port and the remainder to the latter. Lead shipments went to New York, Hamburg, Rotterdam, Havre, and Liverpool, over 50 per cent going to the first named port. All the copper shipments were consigned to New York; the arsenic and antimony shipments went to Hamburg, Genoa, and Newcastle. The total tonnages of the ore and metal exports for the first ten months of the present year are: Lead in bars, 179,830; zinc concentrates, 162,186; calcinated zinc ores, 36,117; copper, 10,604; arsenic, 4,874; zinc in bars, 4,015; antimony, 894.

Machinery is en route from California for the new smelter at Urias, near Mazatlan, Sinaloa.

Problems of Economics and Law Studied at Mining Congress Convention

By A. H. Hubbell
Associate Editor

SIMPLER PROGRAMS are now the rule at annual conventions of the American Mining Congress. The work of the reporter and the conscientious delegate who feels that he must take in everything going on is easier than it was. Simultaneous sessions once were numerous, and the task of covering everything often brought to mind the classical effort of the one-eyed man who went to a three-ring circus.

This year's convention, the thirtieth of its line, was held in Washington, as were the two preceding. In the capital, where the organization has its headquarters, the sessions find their natural setting. There the Mining Congress has the advantage also of being able to bring its members and delegates into contact with those officials of the government who directly or indirectly are interested in the mining industry.

This advantage was turned to good account on the present occasion. The bureaus had their day, and the "bureaucrats" their hour on the convention program. Geological Survey, Bureau of Mines, and Bureau of Internal Revenue —each seized the opportunity given it to bring before the assembled delegates its division chiefs and important men to tell the convention what they were doing for the mining industry and how the work was being done. An excellent aid to visualizing the organization of these bureaus and the scope of their activities this proved to be.

The convention was held at the Hotel Mayflower. Many distinguished men were present. The opening session was honored by the Secretary of Commerce, Mr. Hoover, the annual banquet by the Speaker of the House, Mr. Longworth. Two Senators, Mr. Watson, of Indiana, and Mr. Oddie, of Nevada, had place on the convention program. Senator King and Senator Pittman made their appearances also. Furthermore, be it known that it was on Saturday afternoon, long held sacred to sport and recreation, that Senator Watson spoke. Rarely have conventions been so zealous as to violate the traditions of the forty-four-hour week. It was on Thursday, Dec. 1, that the opening session came to order.

Bradley Elected President

The highest office of the Congress is customarily bestowed now upon a coal man, now upon a metal miner. The choice this year fell upon J. G. Bradley, of Dundon, W. Va., president of the Elk River Coal & Lumber Co. He succeeds William H. Lindsey, of Nashville, Tenn. The honor thus remains with the South, a tribute to the increasing importance of that section of the country. The new vice-presidents, in their order, are Robert E. Tally, managing director of the United Verde Copper Company, of Arizona; George B. Harrington, of Chicago, president of a coal company, and Jesse F. McDonald, of Leadville, Colo. Messrs. Bradley, Archibald Douglas, and Sidney J. Jennings were re-elected to the board.

J. G. Bradley

James F. Callbreath, organizer of the Mining Congress and its energizer for thirty years, was re-elected secretary. Without him the Congress would seem like something else. Presidents come and presidents go, but Mr. Callbreath, as secretary, is a hardy perennial of geniality and organizing ability.

A feature of these conventions, though one that is scarcely mentioned on the program, is the organization's staff and the service that it renders to those who register. Chief among its members is Mrs. E. R. Coombes, the assistant secretary of the Congress and Editor, no less, of the *Mining Congress Journal*. Another is Mr. E. H. Pullman, the convention reporters' friend, who has to do with matters of publicity. Prominent at each convention, moreover, is the distinguished form of Dr. Henry Mace Payne, the organization's consulting engineer; Mr. McKinley W. Kriegh, secretary of the Tax Division; and Mr. George H. Bailey, whose title of counsel only hints at the importance of his service.

These sketches, together with the picture of the throng of delegates, standing in groups or sauntering through the elegant and anything-but-puritanical surroundings of the Mayflower, or seated on the hard but beautifully upholstered chairs in the grand ballroom where the convention met—all these may serve to give the reader an idea of the background and atmosphere of the occasion.

Convention Adopts Only Four Resolutions

Remarkable self-restraint was displayed by the convention this year in the matter of resolutions. Only four were adopted. They were, in abstract form, as follows:

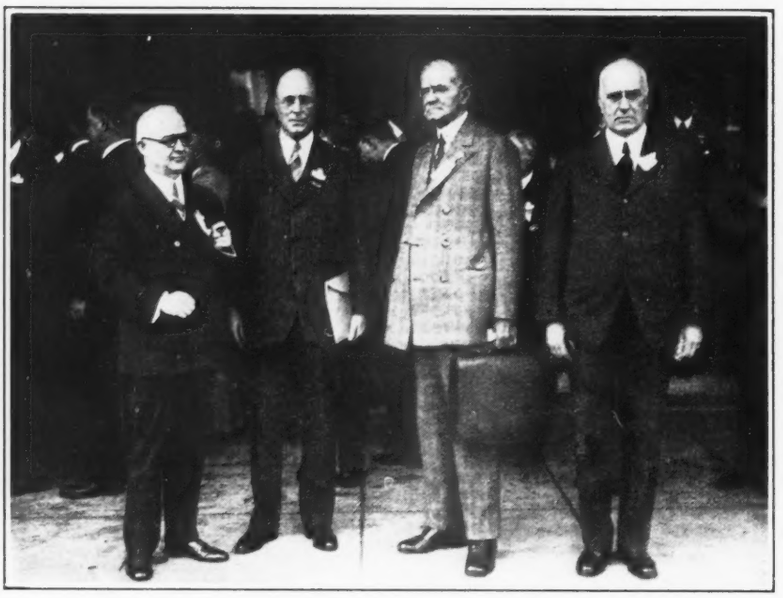
1. Commending the undeveloped fields in the South to the favorable consideration of the mining industry of the nation.
2. Instructing the Mining Congress to make a thorough investigation of the Leasing Act of 1920 and report at the next annual meeting.
3. Urging adequate appropriations for the Bureau of Mines and U. S. Geological Survey.
4. Urging that the provisions for consolidated returns in the present Revenue Act be continued in the pending act substantially as they stand in the Revenue Act of 1926 and as they are now administered by the Treasury Department.

The Proceedings

Preceding Mr. Hoover on the program of the opening session, the retiring president, Mr. Lindsey, outlined briefly the scope of the activities of the Mining Congress.

Secretary Hoover had for his subject the economic importance of mining to the nation. The national life could not survive suppression of the mineral industry for twenty-four hours, he said. Although the industry was ranked second to agriculture, its final products had a value of twenty billions annually on reaching the ultimate consumer, this being equivalent to those produced by agriculture. In its raw-material stage, said Mr. Hoover, the industry paid in direct taxes to the government more than five times the amount levied upon all other raw material industries put together. (The text of Secretary Hoover's speech will appear in full in next week's issue.)

Sidney J. Jennings, following Mr. Hoover, made a plea for unity in the natural-resource industries. "The sale of products of natural resources, other than water power, is regulated by intensive competitive effort to dispose of a superabundance of products," he said. "Two possibilities of unity exist: If, instead of the intense competitive struggle to develop more and more these great sources of wealth, some form of co-ordination could be adopted by which



Left to right, William H. Lindsey, retiring president; Senator Oddie, Secretary Callbreath, and Sidney J. Jennings

only sufficient of the natural resources would be developed in time to supply the effective demand," said Mr. Jennings, "more efficient use of the total products of the subsoil would result, although possibly some of the skim milk of these resources might have to be absorbed by the present generation instead of leaving it for use in the future.

"Also, if some form of co-operation could be brought about by which the prices of products of the subsoil were stabilized at a figure closely approximate to or higher than the average figure for a term of years, not only would the producer be benefited, but the manufacturer would be less dependent upon gambling in raw materials for profit, and the consumer would be benefited by having a more uniform and closely figured price.

"Investigation of prices obtained for coal, oil products, and copper, much of which has been shipped abroad, shows that we have been dispossessing ourselves of natural resources in large measure for the benefit of other nations, at a price which will not permit of replacement when exhausted," said Mr. Jennings.

R. V. Norris, discussing Mr. Jennings' paper at the invitation of the chair (H. Foster Bain presided), expressed the opinion that in consolidation lay the way out of too much production in the coal industry. Three or four large consolidations, not to monopolize but to direct the industry, would do, he said. Dr. Bain remarked pertinently that a point to be considered was whether any step should be taken to control the entrance of new producers, if such consolidation were effected.

Industrial Situation Reviewed

Luncheon for all, at the Mayflower, followed at the conclusion of the morning session. After this refreshment came short talks on the condition of the industry. A. G. McKenzie, of Salt Lake City, presented statistics of Utah's metal production in an unusual way. Julian D. Conover, secretary of the Tri-State Zinc and Lead Ore Producers' Association, followed with an excellent paper on the world zinc industry in 1927. E. W. Parker, of the Anthracite Bureau of Information, spoke briefly on conditions in his field. Judge J. H. Hand, of Arkansas, told how his undeveloped mining state had produced $87,000,000 in mineral products in 1926. This huge sum, of course, represented for the most part the state's petroleum output.

Legislation and Mining

Mr. Bradley occupied the chair during the afternoon. He himself spoke briefly on the subject of "Legislating for Natural Resources." It was questionable, he said, whether some restriction should be placed on the amount of coal produced. The mining industry was 100 per cent against restrictive legislation, because it interfered with the economic development of the country and with the lives and relationships of people. Our knowledge of economic law was so limited, he said, that we could not be sure as to the effect that a curb might have upon ourselves.

The chairman then introduced Senator Oddie, of Nevada, chairman of the Mines and Mining Committee of the Senate. Mr. Oddie's topic was: "What Is on the Legislative Calendar for Mining?" One of the things that the new Federal Congress will doubtless have to consider is the advisability of attempting some measure of control over oil production. Such control would be unconstitutional, declared Mr. Oddie, and to support his position he advanced an argument strongly reminiscent of the Report of the Committee of Eleven of the American Petroleum Institute. The Senator's views are shared by many, as this would indicate. Conservation was necessary, the Senator admitted, however. The petroleum industry must conserve its oil resources, reduce waste, and improve methods of production, refining, and marketing, he said.

Referring to the Budget Bureau, the Senator declared that it had usurped the powers of Congress and was utterly lacking in the technical and economic knowledge necessary to determine the needs of the Bureau of Mines and the Geological Survey. He contrasted the small appropriation of $4,000,000 granted to mining with the huge sum allotted to agriculture. Furthermore, agriculture was allowed $5,000,000 for economic research, and mining only $300,000.

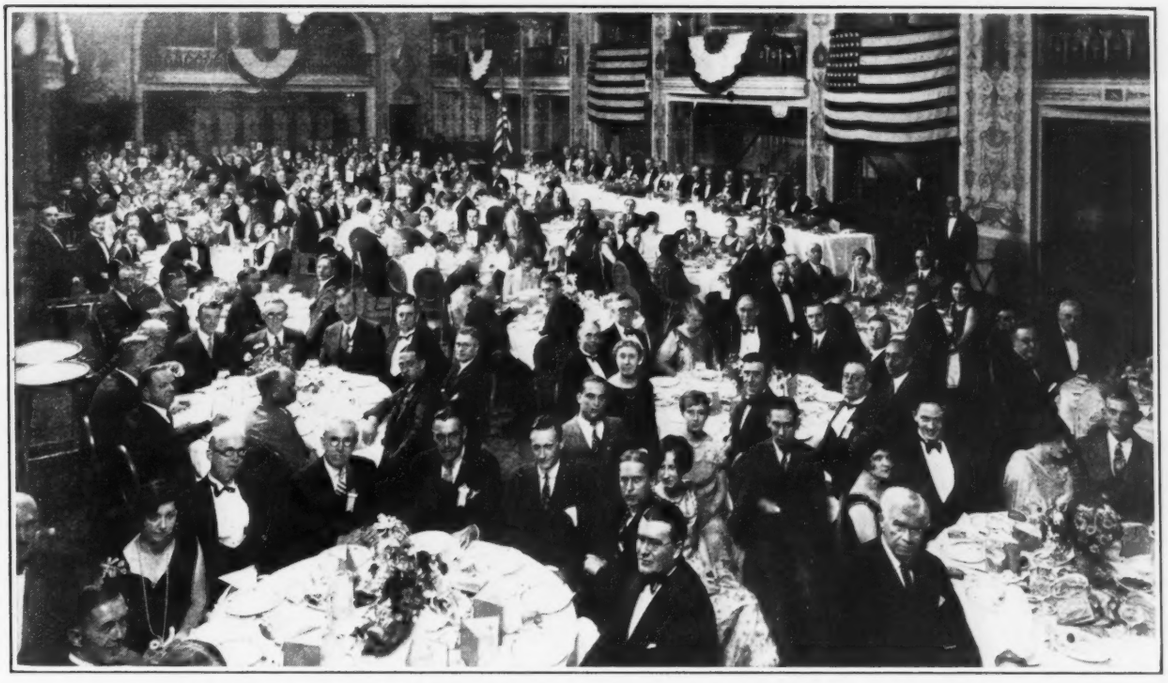
Announcement that a new division had been born to the Bureau of Mines that very day marked the Bureau's "hour." The newcomer has been named the Division of Rare Metals and Non-Metals. It will remain under the watchful care of Frank L. Hess.

State Rights—Centralized Government

A. Cressy Morrison, of the Union Carbide Company, spoke on "International Centralization as Suggested by the Geneva Conference." Following him was Lewis W. Douglas, Representative from Arizona, whose topic was "Hydro Power as a Natural Resource," Mr. Morrison presented differing views of American and European industrialists on production, manufacturing, and economics. He had attended the recent conference in an unofficial capacity. As a result of his observations he concluded that the United States should continue to "stay out" of the League of Nations. "It is difficult for representatives of this country to meet the majority opinion against them at these international discussions of economics and stabilization," he said. "The opinion abroad is that the United States is too prosperous. Our delegates found many things in the resolutions that were obviously aimed at this country.

"If we were bound by the League," said Mr. Morrison, "we would be constantly yielding to the majority and it would be dangerous. The attitude of the League is based on general statements which are hard to combat. Europe, furthermore, seems to think that the introduction of machinery in industry will increase unemployment. Labor in the United States well knows that the introduction of machinery in our industries has meant employment for more workers at increased pay. The purchasing power of the people is the key to the progress of the United States."

Mr. Morrison also discussed the cartel idea and the tariff. "Remember that the greatest market in the world is the United States," he said, "and that the country's export business is only 7 per cent of the total volume. We can't afford to break our standard of living down by breaking down the tariff wall."



The banquet of the Mining Congress, in the Grand Ballroom of the Mayflower

Hydro power as a natural resource was actual or potential wealth created by natural processes as distinct from those developed by man, said Representative Douglas. Under no other theory could the provisions of the Water Power Act of 1920 have been justified, or those of earlier acts of Congress, or withdrawals from entry on the public domain of power sites located on both navigable and unnavigable streams.

As a natural resource and as a unit of public service activity, therefore, Mr. Douglas held, hydro power must be developed and sold, in the absence of "mid-Victorian competition," under government regulation. The only alternative was state ownership and operation, which, experience taught, would result in anything but the public interest. To determine a proper solution to the problem of substituting regulation and control for state ownership was therefore to solve for the unknown. As long as superpower continued to spread its network of transmission lines, adequate control and regulation, both inter- and intra-state, became more and more essential.

At the session set apart for considering the Sherman Law, Mr. Gilbert H. Montague talked ably on the topic of "Lawful Combinations in Industry." He predicted that more and bigger consolidations would be brought about in the general effort to overcome falling prices and diminishing profits. This movement would be encouraged by the clarification of the anti-trust law by the Supreme Court and its sympathetic administrative interpretation by the government. Never had this sympathetic attitude towards present and future needs of business been as marked as now, he said.

"Business men are only just beginning to realize what a variety of new and effective methods for stabilizing business at home and for extending business abroad," said Mr. Montague, "have become available in consequence of recent decisions and rulings by the Supreme Court, the Department of Justice, and the Federal Trade Commission.

"By avoiding unlawful acquisitions of capital stock, and by taking care to leave outside enough competitors to insure effective outside competition, such consolidations can now be set up in many industries in entire conformity to the law and with the utmost advantage to the public interest."

W. G. Merritt, counsel for the Anthracite Operators' Conference, referred to the anti-trust laws as encouraging and not restricting liberty of action in the conduct of business. The anti-trust laws do not carry objections to associations of employers or employees, he said, and they also mean that the right to remain unorganized is equally sacred. The concept of the anti-trust laws must be that neither individuals nor corporations shall interfere with economic laws.

Zinc and the Sherman Law

A. Scott Thompson, of Miami, Okla., suggested that legislation to permit mining companies to operate at a reasonable profit under supervision of a government commission would be a relief. He spoke particularly of the application of the Sherman Act to the zinc industry. "The zinc industry should be permitted to conduct its business free from prosecution in all matters in which approval by the government is first obtained. A government commission could control the immunity granted."

Representatives of the Bureau of the Internal Revenue explained the Bureau's methods at the session on taxation. Mine-valuation procedure, percentage depletion as to oil and gas, and depreciation and auditing were the topics discussed by Messrs. S. P. Hatchett, E. P. McCrorken, Lloyd Gibson, H. G. Nicholls (for Mr. Grimes), and Mr. Cardwell.

The organization and procedure of the Bureau were then described by Robert N. Miller, of Washington. He was followed by Henry B. Fernald, who said that the taxpayer primarily expected fairness in the new tax law. The taxpayers' greatest reason for complaint against the unfairness of the present law was concerned with the complicated administrative provisions, which caused confusion, said Mr. Fernald. The taxpayer must sign and swear to his return regardless of whether he could understand it or not. The oath should be changed, he said.

Proposed simplification of the substance of the federal tax law was discussed by Attorney Charles D. Hamel, of Washington, counsel to the Joint Congressional Committee on Internal Revenue Taxation. This was necessary to overcome the imperfections of the present tax system, he said. "Simpler basic policies in the tax law are needed," he said. "General rules are obscured by numerous exceptions and qualifications. Complicated rules of law are involved in provisions of the act."

Paul Armitage, of New York, chairman of the General Tax Committee of the Congress, who was the last to speak, told the convention that the mining industry in the years from 1922 to 1926 inclusive paid federal and state taxes representing more than 21 per cent of their net income.

Personal Notes

DR. HANS MERENSKY, geologist, returned from the Cape to Johannesburg on Oct. 29.

SYDNEY H. BALL has left New York for the West. He is expected to return about Dec. 16.

H. DEWITT SMITH has returned from Europe, where he visited several mining districts.

THEODORE MARKS, of Lewis & Marks, Ltd., arrived at Johannesburg on Oct. 11, on a short business visit.

ARTHUR A. ZENTNER, author of an article on electrolytic zinc in this issue, sails for Europe today, Dec. 10.

DR. H. PIROW, Government Mining Engineer, left Johannesburg on Oct. 27, on a brief official visit to Cape Town.

THOROLD F. FIELD, managing director of the Roan Antelope mine, in Northern Rhodesia, has been visiting in Duluth.

R. H. CHANNING, JR., director of the mining operations of the H. P. Whitney interests, and R. E. PHELAN are in New York from San Francisco.

J. H. CROSBY, general manager of the J. C. I. Co., Ltd. (Barnatos'), has returned to Johannesburg from England, accompanied by his wife and daughter.

C. M. LOEB, president of the American Metal Company, is in California, and will visit the Pecos property, in New Mexico, on the way back to New York.

JOHN DANIELL, engineer of mines, of Los Angeles, has returned to that city from an extended examination of the Regal and Triangle asbestos mines in Arizona.

GIBSON BERRY, for many years past superintendent for the Round Mountain Mining Company at Round Mountain, Nev., has resigned and is now in San Francisco.

OTTO SUSSMAN has returned to New York from a seven months' journey that included visits to the mines of the Belgian Congo, Rhodesia, and the Union of South Africa.

H. W. THOMPSON, American manager of a mine at Copala, State of Guerrero, Mexico, was kidnapped by bandits recently and held until a ransom of 5,000 pesos had been paid.

GEORGE HARBORDT, general manager for the Peñoles company in Mexico, is in New York on his return from a honeymoon trip in Europe. He will go on to Monterey in a few days.

LESLIE URQUHART and D. P. MITCHELL have sailed from London for Queensland, where they will visit the Mount Isa properties, recently acquired by the Russo-Asiatic Consolidated.

J. B. SCOTT, who early in 1927 took up the position of field manager at the Bowanza mine, Mitta Mitta, Victoria, Australia, has been appointed State Mining Engineer for Tasmania.

DR. A. W. ROGERS, Director of the South African Geological Survey, recently visited East London Cape Colony and made an inspection of siliceous deposits near Fort Grey. He returned to Pretoria on Oct. 23.

WILLIAM BURNS, who has recently taken charge of operations in Northern Rhodesia as manager for N'Changa Copper Mines, Ltd., is being congratulated by his many friends on the birth of a new daughter.

JOHN WATSON, long Johannesburg correspondent of *Engineering and Mining Journal*, left that city recently to accept an engagement with the New Morro-Velho G. M. Company, Ltd., in the Transvaal, for which he will conduct special sampling and assays.

W. F. FERRIS, assistant chief clerk of the United Verde Copper Company, with headquarters at Clarkdale, Ariz., has been transferred to New York, where he will become assistant to H. DE WITT SMITH, managing director in the New York office.

HENRY F. LEFEVRE has sailed for Colombia, South America, where he is to make the examination of several placer properties for the Ludlum Engineering Corporation. After finishing this work he will proceed to Brazil to carry on another examination there.

W. H. STRONGE, mining engineer, and H. C. STOTESBURY left Sydney, Australia, in October last to join a prospecting party in Papua and carry out surveying work in the lesser known parts of that territory, under an arrangement between the Australian Commonwealth and the Anglo-Persian Oil Company.

A. W. ALLEN, Editor of *Engineering and Mining Journal*, represented the American Engineering Council at the convention of the American Mining Congress held at Washington, D. C., on Dec. 1, 2 and 3. A. H. HUBBELL, Associate Editor, reports the convention in this week's issue (pages 949-951).

JOHN P. DELANEY, president of the Whitedelf Mining & Development Company, has returned to New York after spending two weeks in the Clark Fork district of North Idaho inspecting the company's property and planning the development of the Regal property, on Goat Mountain, recently financed by New York interests.

DR. GEORGE H. ASHLEY, geologist of the State of Pennsylvania, will deliver an address before Section E of the Association of American Geographers, meeting at Nashville, Tenn., on Dec. 27 and 28. Dr. Ashley's subject will be "Geology and the World at Large." Section E will conduct a symposium on Dec. 27 on the "Geology of the Gulf States."

W. A. RUKEYSER, consulting mining engineer, returned to New York recently from Colorado, where he was engaged in property examinations. Immediately upon his return it was necessary for him to undergo an emergency operation for appendicitis and he is now convalescing at the hospital. It is expected that Mr. RuKeyser will be in condition to return to his professional practice about the middle of December.

DR. J. MACKINTOSH BELL recently resigned from his administration work as managing director of Vipond Consolidated Mines, Inc., Keeley Silver Mines, and the Pioneer Mining Corporation, so that he may devote his entire time to his technical work as consulting engineer to these companies. R. S. DENIG, general manager of the Huronian Belt Company, Ltd., was appointed to the boards of the various companies above mentioned, vice Dr. Bell.

A. G. MACGREGOR, consulting metallurgist, of Warren, Ariz., recently visited smelters and mills in Canada before sailing from New York on Dec. 7, to establish headquarters in London, England. Mr. MacGregor will maintain a branch office in Warren, Ariz. C. W. CROMWELL, I. H. WYNNE, H. L. KOLBERG, and BEN WILSON, mechanical engineers on the staff of Mr. MacGregor have left for London, where they will be engaged during the next two years in preparing plans for various mills and smelters which will be erected under Mr. MacGregor's direction.

OBITUARY

WALLACE N. TANNER, for many years mechanical superintendent of the Anaconda Copper Mining Company, died on Nov. 23 at his home in Los Angeles.

ROBERT KEFFER, age 38, chief chemist of the Washoe reduction plant of the Anaconda Copper Mining Company, died at San Diego, Calif., on Nov. 19.

JAMES MCDONEL, who was one of the founders of the Philipsburg mining district and prominent in early placer mining in Montana, died on Nov. 18 at the age of 84.

J. V. BLINKHORN, formerly secretary of the General Mining & Finance Corporation, died at East London, Cape Colony, on Oct. 22, aged 68. He was born in Devonshire and went to the Rand 40 years ago.

S. B. DEECKER, a Rand pioneer, died on Oct. 26 in Bellevue East, near Johannesburg. He went to the Rand in January 1887 and was for many years connected with the *Mining Argus*, the first daily paper on the Witwatersrand. He was a grandson of Admiral Deecker, R.N., and had himself been a sailor, previous to 1886.

WILLIAM BERKIN, pioneer Montana mining man, passed away on Nov. 18 at the age of 101 years, 5 months, and 4 days. He was born in Lanshire, England, came to the United States in 1861, and located the second quartz claim in the Butte district. He sold the Mountain Chief claim for $3,700, this claim having since produced tens of millions. He is survived by five children, one of whom, John Berkin, is prominent in the mining and commercial life of Butte.

Market and Financial News

Increased Production of Virgin Aluminum Threatens Market Equilibrium

RAPID expansion in the capacity of the world to produce aluminum is likely to make a decided change in the market position of the metal, according to the *Journal du Four Electrique*. It is pointed out that both production and consumption were on a high level in 1926, the former amounting to approximately 200,000 tons, of which Europe was responsible for about 107,000 tons, and America and Canada for 93,000 tons.

An article in the *Daily Metal Reporter* quoting the French publication continues by saying that undeterred by the threats from purely producing countries like Norway, and from the formidable installations in course of erection in Canada, the capacity of production has been increased in all countries, particularly those that are also large consumers, such as Great Britain, France, and Italy. At the same time the example of Germany in building up an aluminum industry is being imitated by Spain and will probably soon be imitated also by Japan. It may accordingly be asked whether the speed of development is not becoming too great; whether there is not a risk of production outstepping and swamping consumption; and what will happen to the metal now in circulation when the day arrives when the large consumer countries find themselves saturated with their own production.

The European consumption last year, at 73,400 tons, was some 33,000 less than production, whereas in North America consumption exceeded production by about 16,000 tons. The European surplus went for the main part to the United States, and if this situation were to continue, the European works could go ahead with their development plans, certain of a market for their surplus outputs in America and other overseas countries. Unfortunately, the article continues, signs of a general decline in consumption became manifest toward the end of 1926, while the Canadian output began to cast its shadow on Europe.

There has been a further increase in the Canadian exports. Nevertheless, repercussions in Europe are noted, where exports have declined, the German shipments in the first half of 1927 being 3,220 tons, compared with a grand total of 12,470 tons in 1926. On the other hand, France has again become an exporter, with nearly 2,000 tons for the first seven months of the current year. The European situation is, in fact, somewhat complicated, and has been the subject of interpretations—involving questions of price, production, and consumption—which have been characterized as fantastic. According to a statement made by a competent French authority, the price of French aluminum—at present 13.30 fr. per kilogram—has never exceeded 19 fr., which was quoted in July, 1926, and any business done at a higher figure must have related to imported metal. As the pre-war price was 2.60 fr., the coefficient of increase is 5.1. The employment of aluminum has continued to increase steadily, the Aluminum Cartel having stated that consumption in the first half of the current year was 10 per cent higher than in the same period of 1926, which was regarded as a record period. There is at present a slowing down of consumption in France, caused by the rise in the franc.

The reports of discoveries of new bauxite deposits are, according to the authority quoted, correct and cause no surprise to aluminum experts, who are aware that the ore is, after oxygen, the most widely-distributed material in nature. Whereas before the war only rich ores containing 60 per cent alumina and 2 per cent silica were treated, it has been possible for some years to treat economically a 52 per cent ore containing up to 7 per cent silica—a factor to be welcomed in view of the limited existence of high-grade ores. French home prices are on a parity with world prices, less the import duty, the basis price having fallen since the constitution of the cartel from £120 to £115, and subsequently to £107 per ton.

November Dividends of Mining Companies Show Increase

DESPITE gloomy forecasts from some quarters as to the decreased earnings of many non-ferrous metal-mining companies in the third quarter of the current year, dividends paid in November do not reflect such a situation. This is not to say that no shrinkage took place, for it doubtless did, particularly in respect to lead and zinc producers as compared with the corresponding quarter of 1926. However, the list of companies that pay regularly in the February- May- August-November quarter includes an unusual proportion of the bigger companies, such as A. S. & R., Anaconda, and Bunker Hill; and of the gold producers such as Hollinger, Homestake, and Teck-Hughes. The consequence is that the total disbursements in November are larger than in August, as no names are missing from the list, and a number have been added, or the companies have increased their dividends. In this last-named class are Teck-Hughes, which has a greater number of outstanding shares and therefore paid more with the same rate; and Freeport Texas Sulphur, which increased its rate from $1.25 quarterly to $1.50, though the increase is in the form of a larger extra dividend than has been paid recently. Among the names that appear in the accompanying list and that were missing for one reason or another in the August quarter are: California Rand, National Lead preferred B, Plutus, and Aramayo. The rates of yield as indicated in the last column in the table are materially lower than they were, because of the higher valuation placed on most of the shares by the stock market.

Mining Dividends Paid in November

Companies in the United States	Situation	Per Share	Total	Per Cent Annual Yield
American Smelting & Refining	Various	$2.00 Q	$1,219,960	4.6
Anaconda Copper, c, z, l, s	Various	0.75 Q	2,250,000	5.7
Bunker Hill & Sullivan, l, s	Idaho	0.75 M	245,250	6.7
California Rand, s	Calif.	0.01 I	12,800	....
Colorado Fuel & Iron, pfd	Various	2.00 Q	40,000	....
Freeport Texas, s	Texas	1.50 QX	1,094,760	6.2
General Development, h	Various	0.25 Q	30,000	....
Homestake Mining, g	S. D.	0.50 M	125,580	8.6
International Nickel, pfd., n, c	Ont., W.Va.	1.50 Q	133,689	5.6
Miami Copper	Ariz.	0.375 Q	280,168	9.3
National Lead, pfd, b	Various	1.50 Q	375,000	....
New Cornelia Copper	Ariz.	0.50 Q	900,000	7.7
New Jersey Zinc	Various	2.00 Q	981,632	....
Plutus Mining	Utah	0.10 I	99,954	....
U. S. Steel, pfd	Various	1.75 Q	6,305,497	5.1
United Verde Extension, c	Ariz.	0.75 Q	787,500	10
Vanadium Corporation	Various	0.75 Q	282,853	5.2
Companies in other countries				
Amparo Mining, g, s	Jalisco	0.01 Q	20,000	....
Aramayo, t, s, c	Bolivia	1.25 Is	1,050,000	....
Cerro de Pasco, c, s	Peru	1.00 Q	1,122,842	6.0
Dome Mines, g	Ont.	0.25 Q	288,333	7.6
Hollinger Consolidated Gold	Ont.	0.10 4 wks.	492,000	7.4
Lucky-Tiger Combination, g, s	Sonora	0.05 M	35,766	....
Teck Hughes, g	Ont.	0.10 S.A.	$448,000	1.7
Wright-Hargreaves (new), g	Ont.	0.05 Q	275,000	2.8
Total			$17,846,584	

c, copper; z, zinc; l, lead; s, silver; h, holding company; g, gold; n, nickel; s, sulphur; t, tin; Q, quarterly; I, irregular; Is, interim dividend, in Swiss Francs; SA, semi-annual; M, monthly; BM, bi-monthly QX, $1 regular and $0.50 extra.

The Market Report

Copper Leads Non-Ferrous Metal Markets

New York, Dec. 7, 1927—The feature of the non-ferrous metal markets during the week ending today has been the further advance in the price for copper, accompanied by active business for both domestic and foreign accounts. Lead has also sold in excellent volume at somewhat higher prices. Silver on Dec. 6 reached a new high for the present movement, at 58½c. Tin has been firm and quiet and antimony is firmer. The one dull spot has been in zinc, sales being small and prices virtually unchanged.

Copper at 14.125c.

Copper advanced nearly ½c. per pound during the week ending today. For the sixth consecutive week domestic sales have been very good; and the foreign market has continued the activity that has marked the last two months. Three advances during the week seem only to have whetted the appetite of foreign buyers, and domestic consumers have felt forced to join the buying movement with the best grace they can muster. The successive advances in the c.i.f. price were as follows: on Dec. 2 from 14.05c. to 14.25c., on Dec. 5 to 14.35c., and on Dec. 7 to 14.50c. The advances in the domestic market were made sooner by some sellers than others, which accounts for the range in prices for the individual days. Some metal was to be had this morning at 14.075c., delivered in Connecticut, but this afternoon this seems to have disappeared and some producers have advanced their price to 14.25c. Several selling agencies have declined to quote on March metal, whereas others have been willing to take orders that were spread over the first quarter. Generally speaking, there is a tendency to meet requirements further ahead than in recent months. Even if some slacking in buying develops during the next few weeks, the sellers are in so comfortable a position that no reaction in the price seems likely in the near future.

Daily Prices of Metals

Dec.	Copper	Tin		Lead		Zinc
	Electrolytic, N. Y.	99 Per Cent	Straits	N. Y.	St. L.	St. L.
1	13 525@13 65	58 375	59 00	6 50	6 325	5 85
2	13 65@13 775	58 375	58 875	6 50	6 35	5 85
3	13 75	58 25	58 75	6 50@6 55	6 35	5 825@5 85
5	13 775	58 625	59 125	6 50@6 55	6 35@6 375	5 85@5 875
6	13 775@13 875	58 625	59 125	6 50	6.35	5 85
7	13 85@13.90	58.75	59.00	6 50	6 325@6 35	5 825@5.85
	13 754	58 500	58 979	6 508	6 346	5 848

Average prices for calendar week ending Dec. 3, 1927, are: Copper, 13.625; 99 per cent tin, 58.229; Straits, 58.896; N. Y. lead, 6.442; St. Louis lead, 6.256; zinc, 5.858; and silver, 57.979.

The above quotations are our appraisal of the major markets for domestic consumption based on sales reported by producers and agencies. They are reduced to the basis of cash, New York or St. Louis, as noted. All prices are in cents per pound.

Copper, lead, and zinc quotations are based on sales for both prompt and future deliveries; tin quotations are for prompt delivery only.

In the trade, copper prices usually are quoted on a delivered basis; i.e., delivered at consumer's plant. As delivery and interest charges vary with the destination, the figures shown above are net prices at refineries on the Atlantic seaboard. Delivered prices in New England average 0.225c. per pound above those quoted, and prices at so-called Middle West destinations, 0.325c. above.

Quotations for copper are for ordinary forms of wire bars, ingot bars, and cakes. For ingots an extra 0.05c. per pound is charged and there are other extras for other shapes. Cathodes are sold at a discount of 0.125c. per pound.

Quotations for zinc are for ordinary Prime Western brands. Zinc in New York is now quoted at 0.35c. per pound above St. Louis, this being the freight rate between the two points.

Quotations for lead reflect prices obtained for common lead, and do not include grades on which a premium is asked.

London

Dec.	Copper			Tin		Lead		Zinc	
	Standard		Electrolytic						
	Spot	3M		Spot	3M	Spot	3M	Spot	3M
1	59 9/16	59 13/16	65	268½	265¼	22⅛	22 5/16	26⅜	26 3/16
2	60¼	60 7/16	65¼	267⅞	265	22¾	22 15/16	26½	26¼
5	60⅜	60⅝	65¾	269	265⅜	22⅞	23 3/16	27	26 11/16
6	60⅜	60½	65¾	269¾	265½	22 7/16	22¾	26¾	26½
7	60 11/16	60 13/16	66½	271	265⅜	22⅛	22 7/16	26 9/16	26¼

The above table gives the closing quotations on the London Metal Exchange. All prices in pounds sterling per ton of 2,240 lb.

Silver, Gold, and Sterling Exchange

Dec.	Sterling Exchange "Checks"	Silver		Gold London	Dec.	Sterling Exchange "Checks"	Silver		Gold London
		New York	London				New York	London	
1	4 87⅜	58	26 13/16	84s11¼d	5	4 87 11/16	58⅜	26 15/16	84s11½d
2	4 87⅝	58	26 13/16	84s11½d	6	4 87¾	58½	27	84s11½d
3	4 87⅝	58	26 13/16	.....	7	4 87 11/16	58⅝	26¾	84s11½d
					Avg.	58.167			

New York quotations are as reported by Handy & Harman and are in cents per troy ounce of bar silver, 999 fine. London silver quotations are in pence per troy ounce of sterling silver, 925 fine. Sterling quotations represent the demand market in the forenoon. Cables command three-eighths of a cent premium.

Lead Active at the Advance

Though lead prices underwent a sharp advance last Thursday, there was no let-up in buying; in fact, demand for the next two or three days after the increase was made was better than it had been before. On that day, Dec. 1, the American Smelting & Refining Company advanced its contract price from 6.40 to 6.50c., New York, and the principal seller in the Middle West went to 6.325c., St. Louis, which was subsequently raised to 6.35c. The advance in London culminated on Monday, and with the lower quotations cabled from abroad yesterday and today, there was less insistent demand on this side. A threatened dockworkers' strike in Australia, which might have tied up the shipment of some 16,000 tons of lead a month, perhaps had an influence in raising the London price; at any rate, when the difficulties were reported yesterday to be in process of adjustment, prices came down.

An occasional lot of lead has sold somewhat above the Smelting company's quotation in the East, but there is less disposition to pay premiums today than was in evidence only three or four days ago.

Most of the demand for lead has been of a semi-speculative nature; that is, consumers are buying for shipment further ahead than usual. In the last week, only 8 per cent of the lead sold was for prompt shipment; 21 per cent was for December; and 71 per cent was for January. However, some sellers are finding a distinct improvement in contract requirements for 1928, especially from battery and cable makers, who have had a comparatively poor year in 1927.

Zinc Continues Dull

In spite of the absence of any considerable demand, prices for zinc have remained steady. Until last week business had been brisk and a lull is natural. High-grade is still quoted at 7.75c. New York, on a purely nominal basis.

Note: In printing the Market Report in the Dec. 3 issue, the type became misplaced in the quotations of St. Louis zinc. The correct quotation on Nov. 29 was 5.875@5.90c.; and on Nov. 30, 5.85c.

Tin Remains Firm

Trading in tin has been moderate, with most of the interest on the part of the dealers. Prompt quotations apply also to December and January, later deliveries being about ⅛c. less. Prices have averaged about the same as last week—about 59c. for Straits.

Silver 58⅛c.

The silver market has been steady to firm during the week. The New York quotation on Dec. 6 was 58⅛c., being the highest rate quoted since Feb. 19, 1927. The Indian bazaars have been active as buyers, both for shipment and short coverings, and China has shown little interest, as their parities are below current rate.

Mexican Dollars (Old Mexican pesos): Dec. 1st, 2d, and 3d, 44⅜c.; 5th, 45c.; 6th, 45⅛c.; 7th, 44¾c.

Foreign Exchanges Strong

Six major European currencies are now above parity: pound sterling, Belgian belga, German mark, Swiss franc, Swedish krone, and Dutch guilder; also three South American: the Argentine, Uruguayan, and Chilean pesos. Closing cable quotations on Tuesday, Dec. 6, were: francs, 3.93¾c.; lire, 5.42¾c.; and marks, 23.89¾c. Canadian dollars, $\frac{3}{32}$ per cent discount.

Other Metals

Quotations cover large wholesale lots unless otherwise specified. London prices are according to latest mail advices.

ALUMINUM—Per lb., 98 or 99 per cent grade, price of leading interest, 25c.; outside market, 24.30@24.80c.

ANTIMONY—Per lb., duty paid. New York: Chinese brands, spot business, range for the week 10⅞@11½c. Forward deliveries ⅛ to ¼c. higher.

Cookson's "C" grade, spot, 16⅜c. Needle antimony nominally 8c. for lump and 10c. for powdered. White oxide, Chinese, 99 per cent Sb_2O_3, 15½c.

BISMUTH—Per lb., New York, in ton lots, $1.85@$2.10. London, 8s.

IRIDIUM—Per oz., $110@$115 for 98 @99 per cent sponge and powder. Market dull.

NICKEL—Per lb. ingot, 35c.; shot, 36c.; electrolytic, 39c. (99.75 per cent grade) for single lots of spot metal.

PALLADIUM — Per oz., $50@$52. Small lots bring up to $55.

PLATINUM—Official price quoted by the leading interest on small miscellaneous orders for refined metal, per oz., $72. Dealers and refiners quote the trade for refined metal, per oz., cash, $64@$65. Market moderately active.

QUICKSILVER—Per 76-lb. flask, range for week $127.50@$128.50, depending on quantity. Market quiet. San Francisco wires $129.17. London, £23; market firm.

RHODIUM—Per oz., $50@$55; London £8@£11½, nominal.

Prices of Cadmium, Cobalt, Germanium Oxide, Lithium, Magnesium, Molybdenum, Monel Metal, Osmium, Radium, Ruthenium, Selenium, Tantalum, Tellurium, Thallium, Tungsten, and Zirconium are unchanged from the issue of Dec. 3.

Metallic Ores

MANGANESE ORE—Per long ton unit of Mn. c.i.f. North Atlantic ports, minimum 47 per cent Mn. 36@38c. Caucasian, washed, 53@55 per cent, 38.50@40c. Chemical grades unchanged from quotations in the Dec. 3 issue.

TUNGSTEN ORE—Per unit of WO_3, N. Y.; Wolframite, $10.05@$10.20. Western scheelite, $10.35@$10.50. Market dull.

Chrome, Iron, Molybdenum, Tantalum, and Titanium ores are unchanged from quotations in the Dec. 3 issue.

Lead Ore Advanced in Joplin

Joplin, Mo., Dec. 3, 1927

Blende

	Per Ton
High	$42.20
Premium blende, basis 60 per cent zinc	$38.00@39.00
Prime Western, basis 60 per cent zinc	37.00
Fines and slimes, 60 per cent cent zinc	34.00@36.00
Average settling price, all zinc	35.96

Galena

High	$85.00
Basis 80 per cent lead	85.00
Average settling price, all lead	80.55

Shipments for the week: Blende, 10,685; lead, 1,698 tons. Value, all ores the week, $521,000.

Buyers were freely offering an $85 basis price for lead ore, but sellers were not freely disposing of it, confident in the belief that enormously increased automobile sales would force the price upward. Hopes of a further advance in zinc ore prices remain unrealized, and buyers closed the week with a purchase of 6,880 tons, or approximately one-half their requirements.

Platteville, Wis., Dec. 3, 1927

Zinc Blende	Per Ton
Blende, basis 60 per cent zinc	$39.75
Lead Ore	
Lead, basis 80 per cent lead	$85.00

Shipments for the week: Blende 1,112; lead 120 tons. Shipments for the year: Blende 60,086; lead 1,965 tons. Shipments for the week to separating plants, 2,168 tons blende.

Non-Metallic Minerals

Amblygonite, Asbestos, Barytes, Bauxite, Borax, Celestite, Chalk, China Clay, Diatomite, Emery, Feldspar, Fluorspar, Fuller's Earth, Garnet, Gilsonite, Graphite, Greensand, Gypsum, Iron Oxide, Lepidolite, Limestone, Magnesite, Mica, Monazite, Ocher, Phosphate, Potash, Pumice, Pyrites, Quartz Rock Crystal, Silica, Spodumene, Sulphur, Talc, Tripoli, and Zircon are unchanged from prices in the Dec. 3 issue.

Mineral Products

ARSENIOUS OXIDE (White Arsenic)—Per lb., 4c. Market slack. London, Cornish white, per long ton, £18¼.

Calcium Molybdate, Copper Sulphate, Sodium Sulphate (Salt Cake), Sodium Nitrate, and Zinc Oxide are unchanged from prices in the Dec. 3 issue.

Ferro-Alloys

FERROMANGANESE—Per long ton, domestic and foreign, f.o.b. furnace or c.i.f. port of entry, $100 quoted for first quarter, 1928. Spiegeleisen, 19@21 per cent, $29@$30 f.o.b. furnace.

FERROTUNGSTEN—Per lb. of W contained, 75@80 per cent, 92@95c. f.o.b. works. Dull.

Ferrocerium, Ferrochrome, Ferromolybdenum, Ferrophosphorus, Ferrosilicon, Ferrotitanium, and Ferrovanadium are unchanged from prices in the Dec. 3 issue.

Metal Products

ROLLED COPPER—Sheets, 22¾c.; wire, 15¾c. per lb., f.o.b. mill.

LEAD SHEETS—Full rolled 10c. per lb.; clipped, 10¼c.

NICKEL SILVER—29¼c. per lb. for 18 per cent nickel Grade A sheets.

YELLOW (MUNTZ) METAL—Dimension sheets, 19¾c. per lb.; rods 16¾c. per lb.

ZINC SHEETS — 10c. per lb., f.o.b. works.

Refractories

Chrome Brick, Fireclay Brick, Magnesite Brick, Silica Brick and Zirkite are unchanged from quotations in the Nov. 5 issue.

Steel Production 68 Per Cent of Capacity

Pittsburgh, Dec. 6, 1927

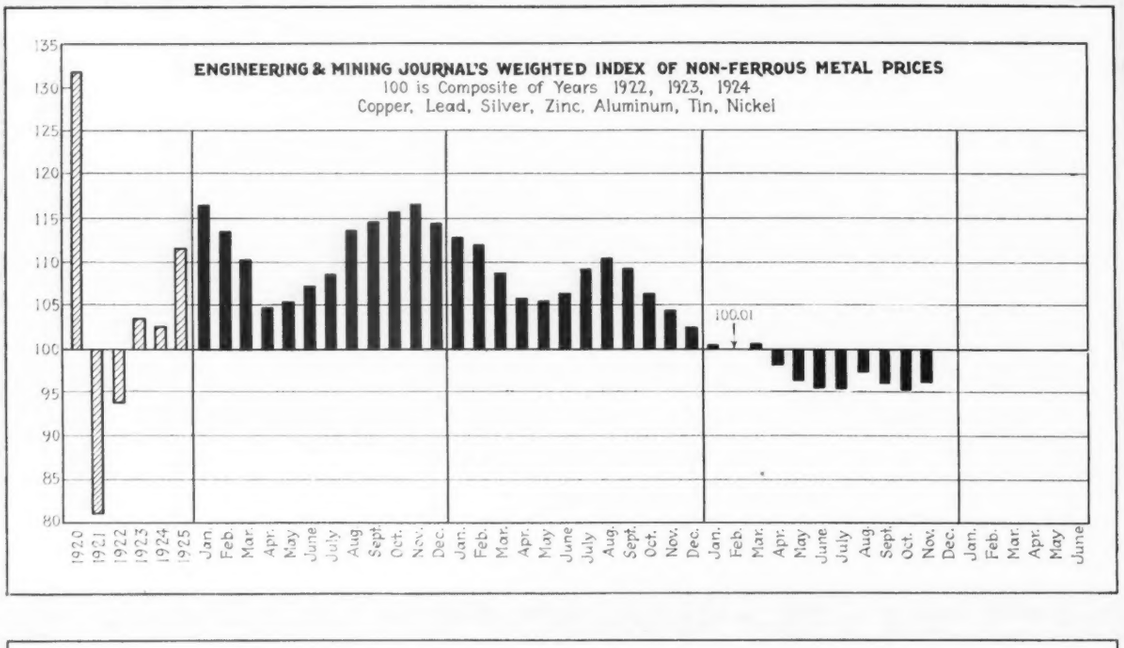
Steel-consuming industries continue running very well except for some seasonal decreases. The automobile

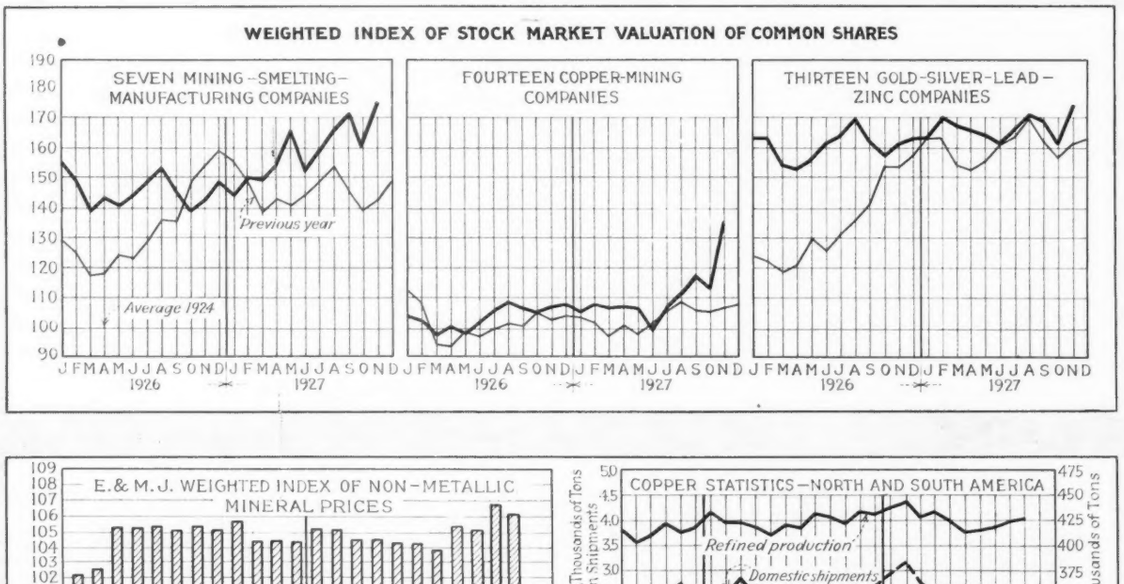
Bars, shapes and plates remain at the recently advanced price of 1.80c., which has not been seriously tested, consumers being well covered. The season tin-plate price has been named at $5.25 per base box, against $5.50 ruling for four and a half years.

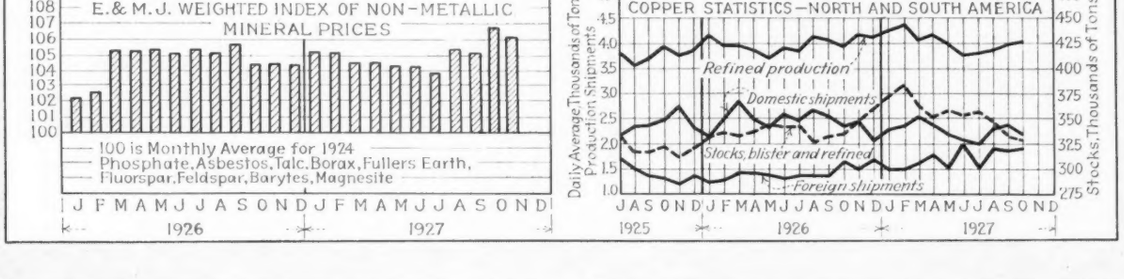
Pig Iron—The market remains dull. Bessemer, $17.75@$18; basic, $17; foundry, $17.25@$17.50, f.o.b. Valley furnaces.

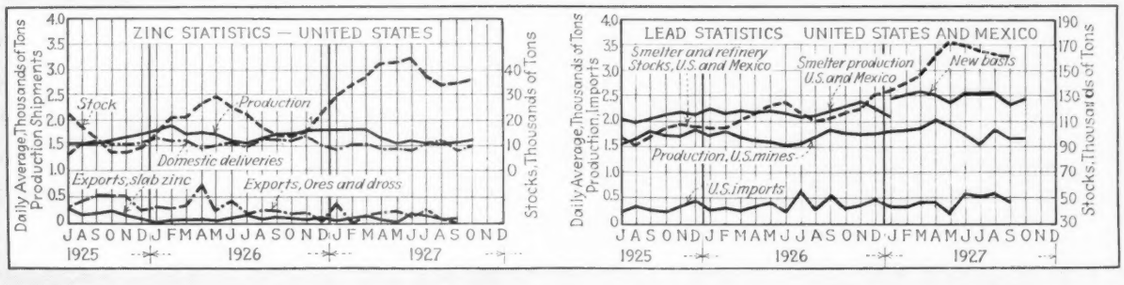
Connellsville Coke—The market is very dull, with prices weak. Heating, $2.50@$2.65; furnace, $2.75; foundry, $4@$4.75.

E.&M.J. Statistics of the Mining Industries


ENGINEERING & MINING JOURNAL'S WEIGHTED INDEX OF NON-FERROUS METAL PRICES
100 is Composite of Years 1922, 1923, 1924
Copper, Lead, Silver, Zinc, Aluminum, Tin, Nickel
100.01
1920
1921
1922
1923
1924
1925
Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov. Dec.


WEIGHTED INDEX OF STOCK MARKET VALUATION OF COMMON SHARES
SEVEN MINING-SMELTING-MANUFACTURING COMPANIES
FOURTEEN COPPER-MINING COMPANIES
THIRTEEN GOLD-SILVER-LEAD-ZINC COMPANIES
Previous year
Average 1924
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D
1926
1927


E.& M.J. WEIGHTED INDEX OF NON-METALLIC MINERAL PRICES
100 is Monthly Average for 1924
Phosphate, Asbestos, Talc, Borax, Fullers Earth,
Fluorspar, Feldspar, Barytes, Magnesite
J F M A M J J A S O N D J F M A M J J A S O N D
1926
1927
COPPER STATISTICS—NORTH AND SOUTH AMERICA
Refined production
Domestic shipments
Stocks, blister and refined
Foreign shipments
Daily Average Thousands of Tons Production Shipments
Stocks, Thousands of Tons
J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D
1925
1926
1927


ZINC STATISTICS — UNITED STATES
Stock
Production
Domestic deliveries
Exports, slab zinc
Exports, Ores and dross
Daily Average Thousands of Tons Production Shipments
Stocks, Thousands of Tons
J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D
1925
1926
1927
LEAD STATISTICS UNITED STATES AND MEXICO
Smelter and refinery Stocks, U.S. and Mexico
Smelter production U.S. and Mexico
New basis
Production, U.S. mines
U.S. imports
Daily Average Thousands of Tons Production, Imports
Stocks, Thousands of Tons
J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D
1925
1926
1927

Review of Current Statistics

By A. B. Parsons
Associate Editor

COPPER easily holds the limelight so far as the non-ferrous metal statistics for November are concerned. Prices for the metal and likewise—almost invariably they move together—prices for the shares in the stock market may with reasonable conservatism be described as soaring. Electrolytic copper averaged 13.319c. per pound f.o.b. Eastern refinery for the month. That is equivalent to about 13.55c. on the delivered basis that usually is quoted in the trade. It is necessary to go back to November, 1926, to find an equally high average. The November price is 0.361c. higher than that for October; and 0.949c. higher than the low average for June, 1927. Moreover, as this is written on Dec. 6, the price seems reasonably strong at 13.875c., refinery. If this average is maintained during December, a net gain of 1.5c. in six months will be shown.

It is no wonder, then, that the price index for copper mining shares jumped suddenly to a level far above any reached in the last four years, at least. The highest recorded since 1923 was 117.6 in September, 1927; but the index for November was 135.3. Of course the ebullient condition of the entire stock market, that has carried share prices, in general, to altitudes never before approached, has been a factor, as evidenced by the sharp climb of the other indexes shown on page 956. At the same time it is evident that the improved position of the metal has had a potent influence.

Several trends and developments have contributed to the improvement in the market for the metal. Statistically the position has shown steady improvement since last February, as indicated on the accompanying charts. World production has been at a definitely lower rate than it was in the last two months of 1926 and the first two of the current year. The same situation is shown in the data on production of refined metal in North and South America, although there has been a gradual slight increase in recent months. Domestic deliveries in the aggregate have not been so large as they were during 1926, but shipments abroad have improved tremendously; and the consequence, taken in conjunction with the lower output, has been a decided shrinkage in the stocks of blister and refined in America. Also, a marked decline in British stocks is known to have taken place, so that the supply of metal above ground is smaller than for a long time. Formation of the Copper Institute last month has doubtless had a favorable sentimental effect on the market. The program calls for the collection and distribution of complete and accurate statistics on production, stocks, sales (for current and forward positions), and prices. It should prove to be a very valuable "weapon" in the hands of sellers and producers if they use it advantageously.

E.&M.J. Weighted Index of Non-Ferrous Metal Prices

100 Is Composite for 1922-3-4

1920	130.92
1921	80.80
1922	93.94
1923	103.43
1924	102.63
1925	111.74
1926	107.74

	1925	1926	1927
May	105.34	105.43	96.41
June	107.19	106.68	95.55
July	108.81	109.08	95.42
August	113.61	110.22	97.25
September	114.66	109.27	96.01
October	115.64	106.20	95.36
November	116.69	104.21	96.22
Average first eleven months	111.53	108.23	95.44

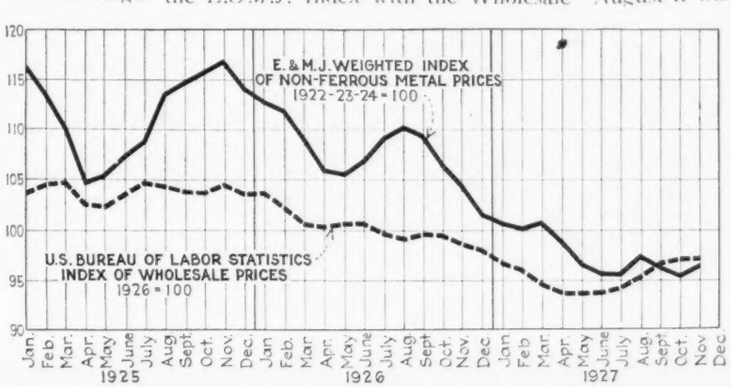
After two months of decline—touching in October the lowest level since 1922—the *Engineering and Mining Journal* Weighted Index of Non-Ferrous Metal Prices turned upward again, reaching 96.22. This is almost exactly 8 units below the figure for November, 1926. Copper, of course, and silver were the most important factors in the increase. Zinc, which reached the lowest level since 1922, with an average price for the month of 5.745c., was the principal bearish influence, but was assisted by aluminum, now down to 25c. per pound, and to a less extent by tin.

The accompanying graph comparing the *E.&M.J.* Index with the Wholesale Price Index of the Bureau of Labor Statistics shows the relative lower price level during the last year of the non-ferrous metals as a group, when compared with other major commodities. It will be observed that the Bureau of Labor Statistics has revised its index, so that the basis of comparison is now the year 1926 instead of 1913, that had been regarded as the "normal" until a month ago. As the *E.&M.J.* Index is based on the three-year period from 1922 to 1924, the comparison is relative rather than absolute; but it is evident that metal prices have declined much more sharply than other prices.

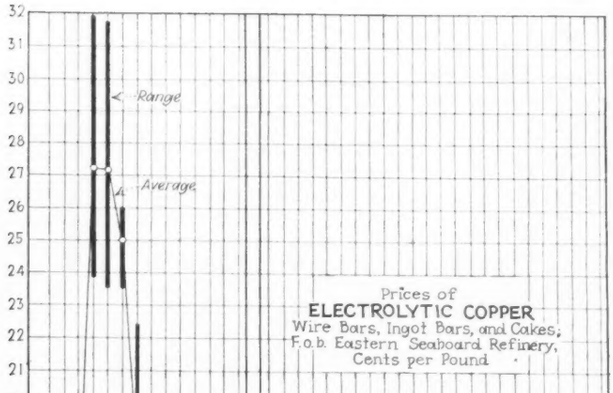
Except for a decline in barytes, no change of consequence developed in non-metallic mineral prices during November. Prices for crude asbestos were advanced, but our index takes into consideration the price of "paper stock" only, so the change is not reflected.

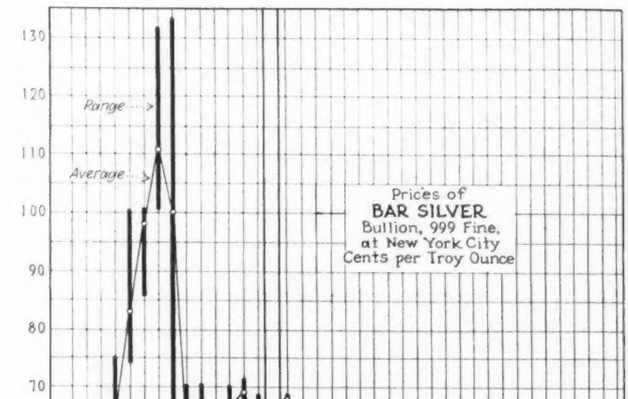
Of all the mining stocks that enter into the three indexes presented on page 956 only two recorded a net decline in November, and they were inconsequential. Homestake and Cresson, two gold producers in the United States, were off, fractionally. Homestake, at 70, however, must be considered high from any point of view. Among the big gains in the mining-smelting-manufacturing group are those of Anaconda, American Smelting & Refining, National Lead and U. S. Smelting. Conspicuously strong "coppers" were Kennecott, Chile, Calumet & Arizona, Nevada Consolidated, and Calumet & Hecla, with Granby and Magma among the smaller companies. However, there is little need for pointing out particular companies, for there is virtually no exception to the general trend upward. The significant thing, as has already been pointed out, is that the strength in "coppers" is more pronounced than in the other groups.

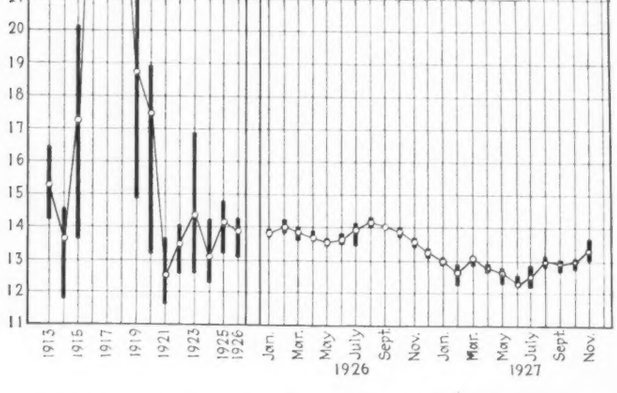
Production and other tonnage statistics for the metals aside from copper show no decisive trends. World's production rate for silver, according to the latest figures, is increasing and in August it was but little below the peaks reached in February and again in November, 1926. A trifle more zinc and a trifle less lead were being produced in October than in the preceding month; and by the same token stocks moved slightly in the same direction for the respective metals. However, in the case of both metals stocks are lower at the end of October than they were at the high points reached earlier in 1927.

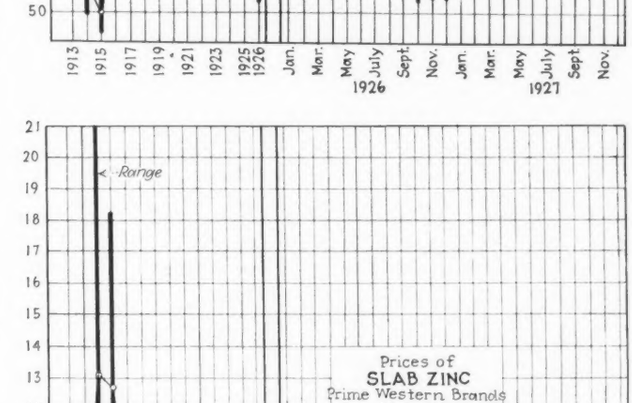


Metal Price Curves

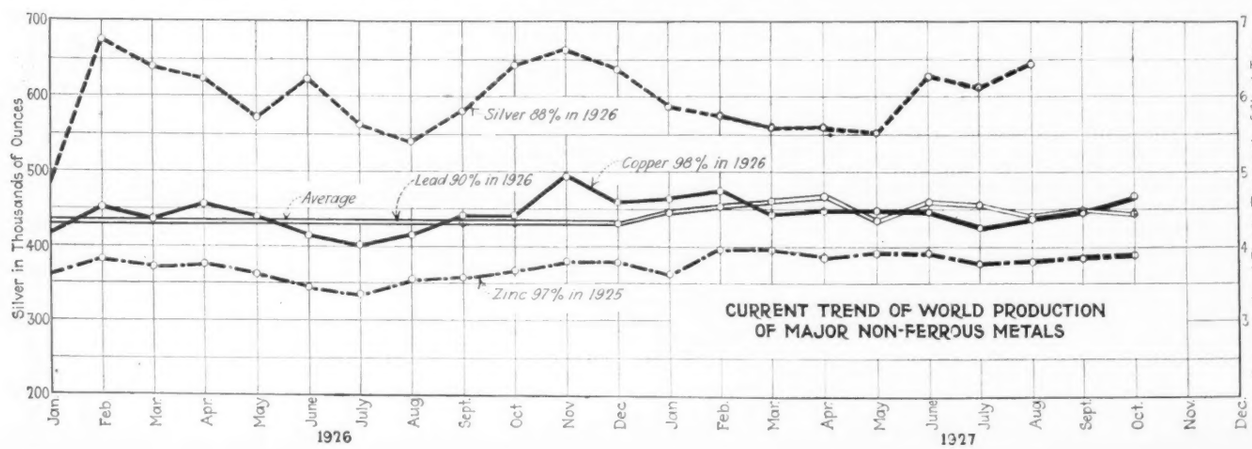








THE CURVES below are not to be considered as permanent records of production. They show merely the current trend in terms of daily output according to the latest estimates of the American Bureau of Metal Statistics. The figures represent production from countries that produce approximately 98 per cent of the world's copper, 97 per cent of the zinc, 90 per cent of the lead, and 88 per cent of the silver. The figures for lead on the new basis are not available for the individual months of 1926; and accordingly a horizontal line showing the monthly average reduced to a daily rate is shown. Delay in receipt of statistics from Mexico accounts for the failure of the silver curve to be up to date.



Mining Stocks—Week Ended December 3, 1927

Stock	Exch.	High	Low	Last		Last Div.
COPPER						
Anaconda	New York	53⅛	51½	53	Oc.15, No.21 Q	0.75
Arcadian Consol.	Boston	1⅝	1½	1⅝		
Ariz. Com'l	Boston	6	5⅛	5⅝	Jy. 18, Jy. 30	0.25
Calaveras	N. Y. Curb	...	...	1⅜		
Calumet & Arizona	New York	...	...	96½	De. 3, De. 9 Q	1.50
Calumet & Hecla	Boston	19¼	18⅛	18⅜	No. 30, De. 15 Q	0.50
Cerro de Pasco	New York	68¾	66⅛	67⅛	Oc.13, No.1 Q	1.00
Chile Copper	New York	38⅛	36⅛	37⅛	De. 2, De. 30, Q	0.62½
Con. Coppermines	N. Y. Curb	4⅝	4½	4⅝		
Copper Range	Boston	17⅛	16	16⅜	Ap.2, My.2, A	1.00
Crystal Copper	BostonCurb	*43	*39	*42		
East Butte	Boston	2	1⅞	2	Dec. 1919	0.50
Granby Consol	New York	39⅜	36⅝	39⅜	Jn.15 Jy. 1 Q	1.00
Greene Cananea	New York	115	86½	107½	Nov., 1920	0.50
Howe Sound	New York	44½	41⅜	43	Oc.1, Oc.15, Q	1.00
Inspiration Consol	New York	20	18⅝	19½	Ma.17, Ap.4, Q	0.25
Iron Cap	Boston Curb	3	2½	2⅝		
Isle Royale	Boston	13¼	12⅛	13¼	Se. 30, Oc. 15, Q	0.50
Kennecott	New York	83½	81⅛	82	De. 2, Ja.3 Q	1.25
Magma Copper	New York	50½	48⅛	48⅜	Se.30,Oc.15 Q	0.75
Mason Valley	N. Y. Curb	1¼	1	1¼		
Miami Copper	New York	17⅜	16	17⅛	No.1, No.15, Q	0.37½
Mohawk	Boston	49¾	48	48½	Oc.31, De. 1 Q	2.00
Mother Lode Coal	New York	4⅛	2⅜	3	Jn.10, Jn.30	0.25
Nevada Consol	New York	19½	17⅛	19⅜	Se. 16, Se. 30 Q	0.37½
New Cornelia	Boston	25⅝	25	25⅛	No.4, No.21 Q	0.50
Noranda	N. Y. Curb	25⅛	24⅜	24⅝		
North Butte	Boston	1⅛	1	1⅛	Oct., 1918	0.25
Ohio Copper	N. Y. Curb	*90	*80	*83	Sept. 1926	0.03
Old Dominion	Boston	12	11	11⅞	Dec., 1918	1.00
Phelps Dodge	N. Y. Curb	128½	125	126½	De.17, Ja.3 Q	1.50
Quincy	Boston	14⅛	13½	14⅛	March, 1920	1.00
Ray Consolidated	New York	....	....	15½	Ap.20, Ap. 30	0.25
St. Mary's Min. Ld.	Boston	29	26½	28⅞	Fe.10, Ma.10	2.00
Seneca Copper	New York	2⅛	1⅞	2⅛		
Shattuck-Denn	Boston Curb	11	9	11		
Tenn. C. & C.	New York	10½	9⅝	10⅛	No.30, De.15, Q	0.12½
United Verde Ex	N. Y. Curb	33⅜	28⅛	33⅛	Oc.6, No.1 Q	0.75
Utah Copper	New York	....	....	130	Se. 16, Se. 30 Q	1.50
Utah Metal & T	Boston	1⅜	1⅛	1⅜	Dec., 1917	0.30
Walker Mining	Salt Lake	*60	*55	*56		
NICKEL-COPPER						
Internat. Nickel	New York	72⅛	66	71⅛	Se. 16, Se. 30 Q	0.50
Internat. Nickel pfd.	New York	...	...	108	Oc. 13, No. 1 Q	1.50
LEAD						
Gladstone Mtn	Spokane	*15⅛	*15	*15	June, 1927	0.005
National Lead	New York	132⅛	129½	129⅜	De. 16, De. 31 Q	1.25
National Lead pfd	New York	137	136½	136⅝	Ja.13, Fe. 1 Q	1.50
St. Joseph Lead	New York	40⅜	37⅛	40	De.10,De.20,QX	0.75
ZINC						
Am. Z. L. & S.	New York	...	...	7⅛	May, 1917	1.00
Am. Z. L. & S. pfd.	New York	38⅛	37⅛	37⅜	Nov., 1920	1.50
Butte C. & Z.	New York	4¼	4	4⅛	De. 9, De. 24	0.50
Butte & Superior	New York	9⅞	8⅞	9⅜	Se. 16, Se. 30 Q	0.50
Callahan Zn-Ld	New York	2	1⅛	1⅜	Dec., 1920	0.50
Consol.Lead&Zinc'A'	St. Louis	12	12	12	Ma.15, Ap.1 Q	0.25
Eagle-Picher	Cincinnati	24	23¼	23⅜	No.15, De.1 Q	0.40
Eagle-Picher pfd	Cincinnati	...	...	117½	Jn.30, Oc.15 Q	1.50
New Jersey Zn	N. Y. Curb	183¾	179	183⅜	No. 19, De. 10 X	2.00
United Zinc	N. Y. Curb	...	...	*55		
Yellow Pine	Los Angeles	*35	*35	*35	Dec. 1925 Q	0.04
GOLD						
Alaska Juneau	New York	1⅜	1¼	1⅜		
Argonaut	Toronto	*38½	*35	*35¼		
Barry-Hollinger	Toronto	1.25	1.07	1.12		
Con.W.Dome L.new.	Toronto	*18	*15	*15		
Cresson Consol. G	N. Y. Curb	2	1⅛	1⅛	Se. 30, Oc.10 Q	0.10
Dome Mines	New York	14	12⅞	13¼	Se.30, Oc.20 Q	0.75
Golden Cycle	Colo.Springs	†1.75	†1.70	....	No.30, De.10 Q	0.04
Hollinger Consol	Toronto	17.50	17.25	17.25	No. 16, De. 2	0.10
Homestake Mining	New York	70½	70½	70½	No.19, No.25 M	0.50
Kirkland Lake	Toronto	2.65	2.55	2.60		
Lake Shore	Toronto	26.74	26.00	26.55	De.1, De.15 QX	0.20
McIntyre-Porcupine	New York	27⅛	27⅛	27⅛	De.1, De.15 Q	0.10
Portland	Colo.Springs	†*30	†*21¼	...	Ap.6, Ap.15, Q	0.02
Rand Mines	New York	...	....	48½	Au.22-29 Am.sh.	1.52
Teck-Hughes	Toronto	11.96	10.90	11.00	Fe.1, X	0.15
Tom Reed	Los Angeles	*35	*25	*25	Dec., 1926	0.02
Tough-Oakes	Toronto	*80	*70	*73		
United Eastern	N. Y. Curb	*45	*45	*45	July, 1924	0.05
Vipond Cons	Toronto	*90	*80	*81	Apr.1, Apr.15	0.03
Wright-Hargreaves	Toronto	7.20	6.90	7.00	Oc.17, No.1	0.05
GOLD AND SILVER						
Carnegie Metals	Pittsburgh	12	12	12		
Con. Cortez	N. Y. Curb	...	...	*20		
Dolores Esperanza	N. Y. Curb	*60	*44	*60	July, 1923	0.05
Premier Gold	N. Y. Curb	2⅜	2⅛	2⅜	Se. 15, Oc. 4	0.08
Tonopah Belmont	N. Y. Curb	1⅛	1⅛	1⅛	Ma.15, Ap.4	0.08
Tonopah Extension	N. Y. Curb	*13	*11	*12	Apr. 1925	0.05
Tonopah Mining	N. Y. Curb	2	2	2	Se.20, Oc.21	0.07½
West End Consol	N. Y. Curb	*4	*4	*4	Mar., 1923	0.05
Yukon Gold	Boston Curb	*74	*65	*74	June, 1918	0.02
SILVER						
Beaver Consol	Toronto	2.16	2.02	2.15	May, 1920	0.03
Castle-Trethewey	Toronto	*90	*82	*85		
Coniagas	Toronto	4.80	4.40	4.80	May, 1924	0.12½
Keeley	Toronto	*80	*75	*75	Se.1, Se.15	0.08
Lorrain Trout Lake	Toronto	...	...	*60	July, 1925	0.05
McKinley-Dar.-Sav.	Toronto	*18½	*17½	*18½	Oct., 1920	0.03
Mining Corp. Can	Toronto.	4.75	4.40	4.50	Jn. 29, Jy.15	0.12½
Nipissing	N. Y. Curb.	6¼	6¼	6¼	Se.30, Oc.20 Q	0.07½

Stock	Exch.	High	Low	Last		Last Div.
SILVER-LEAD						
Ahumada	New York	4¾	3⅝	4½	Ma. 25,Ap.4,QX	0.12½
Bingham Mines	Boston	57	55½	55½	Se.24, Oc.5 Q	1.00
BunkerHill&Sullivan	N. Y. Curb	134¾	133¼	133⅜	Oc. 31, No.4	0.75
Cardiff M. & M.	Salt Lake	*70	*65	*70	Feb. 5, 1927	0.10
Chief Consol	Salt Lake	2.70	2.45	2.69½	Nov., 1926 Q	0.10
Consti'nMng.&Mill'g	Spokane	*16	*15	*16		
Erupcion	Boston Curb.	*50	*50	*50	Se. 15, Oc.3 Q	0.07½
Eureka Lily	Salt Lake	1.17½	1.15	1.15		
Federal M. & S.	New York	...	...	144	Jn.25, Jn.29	Spec.$10
Federal M. & S pfd.	New York	...	...	94½	No. 12 De 15 Q	0.25
Hecla Mining	N. Y. Curb	16⅜	16⅛	16⅜	No.15, De.15 Q	1.75
Highland-Surprise	Spokane	*11⅛	*11	*11⅛		
Iron King Mining	Salt Lake	*50	*49	*50		
Keystone Mining	Salt Lake	*20⅛	*20	*20⅛	Au. 12, Au. 26	0.07½
Lucky Jim	Spokane	*26	*26	*26		
Lucky Tiger-Com	Kansas City	†7.35	†7.00	....	De.10, De. 20	0.05
Mammoth Mining	Salt Lake	1.90	1.90	1.90	Jn.10, Jn.20 Q	0.05
Marsh Mines	Spokane	1⅛	1⅛	1⅛		
North Lily	Salt Lake	3.27½	3.15	3.27½		
Park Utah	New York	7⅜	7¼	7⅜	Se. 15, Oc. 1 Q	0.20
Plutus Mining	Salt Lake	2.50	2.20	2.33	Oc. 25, No. 10 Q	0.10
San Rafael	San Fran.	*10⅜	*7½	*9½		
Silver King Coal	Salt Lake	10.12½	10.00	10.00	De. 19, Ja.2 X	0.35
Silversmith	Spokane	*21½	*17½	*21½	Oct., 1926 Q	0.02
Strattons Mines	Spokane	*48	*46	*48		
Sunshine M. Co.	Spokane	1.22	1.10	1.22		
Tamarack-Custer	Spokane	*51	*48	*51	Sept., 1924	0.25
Tintic Standard	Salt Lake	12.75	12.12½	12.62½	De.20, Ja.3 QX	0.40
Utah-Apex	Boston	5⅜	5¼	5⅜	Oct., 1926	0.25
IRON						
Bethlehem Steel	New York	55⅜	54	54⅜	Se. 2, Oc. 1.	1.75
Cleveland-Cliffs Iron	Cleveland	110	100	105	Oc. 15, Oc. 25 Q	1.00
Colorado Fuel & Iron	New York	81½	75	78⅜	May, 1921	0.75
Gt. North'n Iron Ore	New York	26⅜	23½	26	Dec. 6, Dec. 28	0.75
Inland Steel	New York	55½	53	55	No. 15, De. 1 Q	0.62½
Replogle Steel	New York	...	...	12⅜		
Republic I. & S.	New York	63⅜	59½	60½	No. 15, De.1 Q	1.00
Republic I. & S. pfd.	New York	105⅛	103	103⅛	De. 14, Ja. 2 Q	1.75
Sloss-Sheffield S. & I.	New York	117	117	117	De. 10, De. 20 Q	1.50
Sloss-Shef. S.&I. pfd.	New York	110	109½	110	De. 20, Ja.3 Q	1.75
U. S. Steel	New York	147⅜	144	146½	No. 30, De. 30 Q	1.75
U. S. Steel, pfd.	New York	139	138	138	Oc.30, No. 29 Q	1.75
Virginia I. C. & C.	New York	....	....	36½	Jan., 1924	1.50
Virginia I.C.&C. pfd.	New York	....	....	60½	De. 16, Ja. 3	2.50
DIAMONDS, PLATINUM, ALUMINUM, VANADIUM, TIN						
De Beers Consol	New York	...	...	27½	Jn. 26, Jn.30	1.45
So. Am. G. & P. New.	N. Y. Curb	2⅜	2⅜	2⅜		
Alum. Co. of Amer.	N. Y. Curb	145½	130	137		
Alum. Co. ofAmer.pf.	N. Y. Curb	104½	104½	104½	Se. 15, Oc 1 Q	1.50
Vanadium Corp.	New York	58½	55	56	No. 1, No. 15 Q	0.75
Patino M. & E.	New York	25⅞	22¾	24⅜	Ap. 27, My. 5	1 sh.
ASBESTOS						
Asbestos Corp.	Montreal	36⅛	35¾	35⅞	Jan., 1926	1.50
Asbestos Corp. pfd.	Montreal	96	95	96	Se.30, Oc.15 Q	1.75
SULPHUR						
Freeport, Texas	New York	100⅛	92⅜	98⅛	Oc.15, No.1 QX	1.50
Texas Gulf	New York	73⅛	70	71	De. 1, De. 15 Q	1.00
MINING, SMELTING, REFINING AND GENERAL						
Amer. Metal	New York	42¼	41⅛	41⅝	No.19, De.1 Q	0.75
Amer. Metal, pfd.	New York	....	....	110	No.19, De.1 Q	1.75
Amer. Sm. & Ref.	New York	177⅛	172	176⅜	Oc.14, No. 1 Q	2.00
Amer. Sm. & Ref. pfd.	New York	131⅛	130⅛	130½	No., Dec. Q	1.75
Consol. M. & S.	Montreal	274½	259	270	Jn. 30, Jy. 15 X	6.25
Newmont Mining	N. Y. Curb	122⅞	122⅛	123⅛	Se.30, Oc.15 Q	1.00
U. S. Sm. R. & M.	New York	46⅛	41⅜	46⅛	Oc. 6, Oc. 15 Q	0.87½
U.S. Sm. R.&M. pfd.	New York	50⅛	49⅜	50⅛	Oc. 6, Oc. 15 Q	0.87½

* Cents per share. † Bid or asked. Q, Quarterly. SA, Semi-annually. M, Monthly. F, four weeks. I, Initial. X, Includes extra. The first date given is that of the closing of the books; the second that of the payment of the dividend.

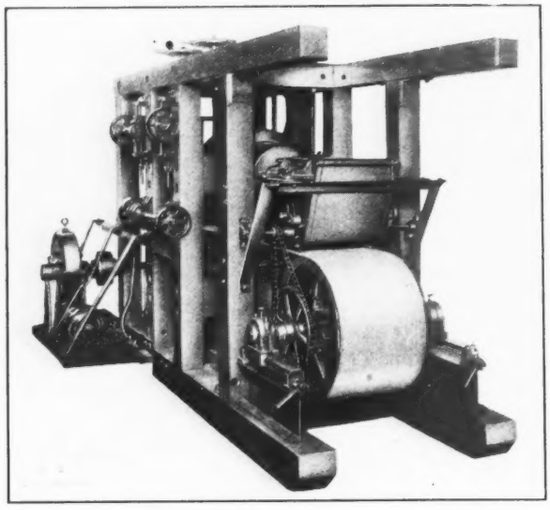
Boston quotations courtesy Boston Stock Exchange; Toronto quotations those of the Standard Stock Exchange of Toronto, by courtesy of Arthur E. Moysey & Co.; Spokane, Pohlman Investment Co.; Salt Lake, J. A. Hogle & Co.; Colorado Springs, Colo., Henry Sachs.

LONDON QUOTATIONS—WEEK ENDED NOV. 21, 1927

Name	High	Low	Last	Date	Amount	Last Div.
Aramayo Mines (25 frs.)	75/7½	73/9	75/—	Nov., 1927	5	p.c. (†)
British Platinum (£1)	—/9	—/3	—/3	Feb., 1925	2½	p.c.
Burma Corpn. (10 rupees)	13/6	12/10	13/1½	Aug., 1927	6	annas*
Bwana M'Kubwa (5s)	4/3	3/3	3/10½			
Camp Bird (2s)	3/3	3/10½	3/3			
El Oro (£1)	4/—	3/6	3/9	Nov., 1924	2½	p.c.*
Esperanza (10s)	—/2	—/2	—/2			
Frontino & Bolivia (£1)	14/1½	13/1½	13/6	July, 1927	5	p.c
Mexican Corpn. (£1)	9/—	7/9	8/3	Dec., 1926	3½	p.c.*
Mexico Mines of El Oro (£1)	18/1½	13/9	16/3			
N'Changa Copper Mining	11/6	8/—	9/9			
Oroville Dredging (£1)	6/4½	6/—	6/3	Dec., 1923	3½	p.c.
Ouro Preto (£1)	2/6	2/—	2/3½	May, 1925	2½	p.c.
Rhodesian Congo Border (£1)	40/7½	38/—	38/9			
St. John del Rey (£1)	10/3	9/9	10 —	May, 1927	3½	p.c.
San Francisco Mines (10s)	27/10½	26/9	27/—	July, 1927	15s.	
Santa Gertrudis (£1)	17/6	16/10½	17/3	July, 1927	7½	p.c.
Selukwe (2s. 6d.)	7/1½	6/4½	7/—	April, 1917	6½	p.c.
S. Amer. Copper (2s.)	2/4½	2/1½	2/3	Nov., 1917	75	p.c.
Tanganyika (£1)	67/7	62/6	63/9	Aug., 1927	7½	p.c.
Union Miniere du Haut-Katanga (Brussels)	10.675	10.200	10.540	July, 1927	182.60	(‡)

* Free of British income tax. † Swiss francs and plus 15 p. c. bonus. ‡ Belgian frs. and free of taxation.

Industrial Progress



A 60,000-ampere-turn magnetic separator, of improved design, which has recently been built.

Improved Magnetic Separators for Idaho Company

TWO large magnetic separators of an improved design which were specially built for the Sullivan Mining Company at Kellogg, Idaho, were completed recently by the Dings Magnetic Separator Company. The machines are to be used in a new concentrator which the former company is building for treating zinc ores. They are of the Rowland-Wetherill type, with a 60,000 ampere-turn rating, and are equipped with an 18-in. main conveyor belt.

Each machine consists of an exceedingly strong and solid wooden frame which supports the electromagnets, the main belt and cross-belt pulleys, and the feed hopper. Driving motor and reduction gear are mounted on an apron supported from one side of the frame. The motor is 2-hp. compound wound, 110-volt direct current, directly connected to an 85:1 worm gear reduction unit. The drive shaft of this unit is connected through a flexible coupling to the shaft of the main-belt drive pulley, the cross-belt pulleys being driven from the shaft by a bevel gear, chain, and sprocket arrangement.

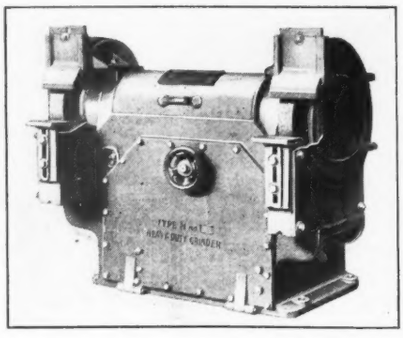
All the pulleys—that is, both main and cross-belt—are mounted on Timken tapered roller bearings, there being two on each main belt pulley shaft, two on each of the double pulley cross-belt shafts, and one each on the two individually mounted cross-belt pulleys. The bearings are lubricated by the pressure grease method, the housings being designed to serve as reservoirs with sufficient capacity to render the necessity of renewing the lubricant a comparatively infrequent occurrence.

The machine is liberally supplied with adjustments. Both of the upper cross-belt pulleys are mounted on individual adjustable bases, so that the tightness of either belt can be adjusted without regard to the other. The main belt idler pulley is also equipped with adjustable take-ups on each end. There is also provision, in the form of handwheels on top of the frame, for adjusting the position of the upper magnet pole pieces with respect to the main conveyor belt.

Another interesting feature of the machine is the method employed of driving the automatic hopper feed directly from the idler pulley shaft. This arrangement not only insures an even distribution of the material over the surface of the main belt, but also regulates the amount released from the hopper in accordance with the speed at the moment.

Heavy-Duty Grinder Acquired

Acquisition of the McArthur type N heavy-duty grinder has been announced by Kling Bros. Engineering Works, of Chicago. This grinder is a powerful machine, capable of taking unusually heavy bites, while maintaining commercial accuracy. Grinding efficiency is secured by the high peripheral speed of the wheels, the easy adjustment, and the three speed pulleys, which allow for keeping the wheel speed constant, assuring continuous, maximum production. The machine is intended for grinding gray iron, malleable and steel castings, iron and steel forgings, and parts of any materials.



A powerful grinder for heavy duty

Line Starters Dust-tight and Oil Immersed

FOR special uses the Westinghouse company is building two important modifications of its standard equipment of line starters. One of these has special provision for excluding dust, all small openings through which dust might penetrate being rendered dust-tight. Another model has all parts in which sparks or arcing might occur immersed in oil. The main current carrying and breaking contacts are oil-immersed; the operating coil is below the surface, as is the interlock. Consequently, under normal operating conditions no explosive gases in or around the starter can be ignited by operation of the starter.

Another interesting development is a water-tight and gas-tight push-button station, in which all the elements that operate to open and close the circuit, and on which there may be sparking, are inclosed in an air-tight chamber. The upper part of this chamber consists of a rawhide diaphragm through which the operative pressure is transmitted to the interior mechanism by an exterior push button. Although originally signed for marine service, this push-button station will find extensive use where its features of gas-tightness and water-tightness make it desirable.

Rock Drill Bulletins Out

FIVE new bulletins on rock drills and kindred equipment have been issued by the Ingersoll-Rand Company. They have been grouped, conveniently bound, in an attractive folder. By their numbers and titles they are:

No. 4422. "Drill Steel Sharpeners."
No. 9225. "Drill Steel and Its Care."
No. 4164. "Paving Breakers."
No. 4071. "Pile Driver for Sheet Piling, Type CC-35."
No. 4161. "Rock Drill Accessories."

In all the group includes about 115 pages.

The history of the drill steel sharpener from 1907, when the J. George Leyner Engineering Works Company designed a model embodying two new principles, is given in brief. The construction and operation of Models No. 50, No. 4 and No. 34, now marketed by Ingersoll-Rand, are described at considerable length, with the aid of many illustrations. A feature is an insert showing a model layout of a practical blacksmith shop for the mine, quarry or contract job.

Manufacture of Swedish drill steel, such as that marketed by the company, is described in the second bulletin. The qualities of the steel are set forth and the proper procedure in heat-treating, sharpening and forging.

Rock drill accessories covered in Bulletin No. 4161 include hose and its connections and couplings; water tanks, throttles, oilers, manifolds, filters and air line lubricators; mountings, steel cone adapters, centralizers and steel blowers.